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TELEPHONES FOR TRAIN DISPATCHING.

While the use of telephones for train dispatching is making great progress in this country, and is being tried out on a large number of roads with almost universal satisfaction, a single note of discord and doubt comes from far-away Hindustan, where the system has evidently never been tried. As is so often the case, believing must be preceded by seeing and trying, otherwise the adherents to the methods of their grandfathers feel certain that the new method will be not be suited to their particular circumstances.

In this instance our contemporary, *Indian Engineering*, makes the novel and somewhat paradoxical objection that its successful working cannot be considered to have been demonstrated until some accident is reported. We understand, of course, that our contemporary does not consider the accident, *per se*, necessary to successful operation, but that accidents are too closely connected to human frailty to be entirely obviated, and that a system is to be judged by the number, character and resulting damage of its accidents, and the possibility of placing responsibility for them. The latter is supposed to be the weak point of dispatching by telephone. To quote: "Without an accident, and inquiry, and a fixing of responsibility, we hesitate to say that its general introduction would be an unmixed blessing. We can picture to ourselves the chaos that would reign at an official inquiry in India should a telephonic message lead to an accident. The sender of the message would deny its dispatch *in toto*; the receiver would not only affirm its receipt, but would amplify its terms with a wealth of imagination possessed only by his kind, and nothing tangible would be forthcoming to prove, or disprove, either statement."

This comment would indicate a deplorable condition of affairs among railroad employees in Hindustan. To our mind, however, the possibility of fixing responsibility for accident does not seem more important than the adoption of a system which will reduce the likelihood of accident, and make it easier for the employees to properly carry out their duties. We are unable to cite a specific case of accident due to the use of the telephone in dispatching, although accidents have occurred under this system. The investigation in one case discloses that an employee had failed to follow the dispatcher's order; in another case the

conditions so much feared in Hindustan were in evidence, for no record had been kept, testimony conflicted, and responsibility could not be placed. For this the telephone system is not, however, responsible, since a proper application of this system includes the recording and filing of every order sent and received, just as when the telegraph is used. It is quite possible with the telegraph system for careless or vicious employees to omit the filing of dispatches or to destroy these as incriminating evidence after an accident has occurred. In this respect the two systems are on a par.

The question of accidents, then, does not enter, unless the accident can be shown to be due to the system, and not to a failure of operators to properly use the system. The lack of any accident of magnitude or character such as to call the superiority of the system into question, after extended use for a number of years, would seem to constitute a very strong argument in favor of, rather than against, the telephonic method of dispatching.

THE ARMY AND THE ENGINEER.

The need of technical men and especially men trained in electrical engineering, in the United States Army, was brought out in a paper which Mr. Caryl D. Haskins read before a joint meeting of the Western Society of Engineers and the American Institute of Electrical Engineers in Chicago, and which is noted in our columns. Following somewhat the same line, the need of engineers in the navy is touched upon in a paper by Commander C. C. Marsh, appearing in the *United States Naval Institute Proceedings*. The opinion of men who have thought upon these subjects, as reflected in the papers referred to, indicate that there is indeed a grave need of a trained reserve to the army and navy.

Electricity has played an important part in the development of our present methods of warfare, especially in regard to the methods of communicating reports and orders and respecting the means of controlling the ordnance and handling ammunition. In both these lines trained skill is a primary necessity. Men trained in the service can have only a limited knowledge of the very necessary principles of engineering unless they have during their training given much time to study, and on the other hand trained engineers in civil life find no time to spend in following the routine drill work of a militia.

The praiseworthy work being done at the electrical school of the Brooklyn Navy Yard gives men an excellent preparation for the routine work of the naval electrician, but hardly fits him for the more original work required of the engineer.

The changed needs of the navy which have produced this demand for engineers in that service was well brought out in Commander Marsh's report by a comparison of the old *Minnesota* (1863) with the *Delaware* (1910). Each was of the same order as to personnel, but the engineering force on the older ship was about nine per cent of the total, while on the newer vessel it is forty per cent. With a total of a little more than 800 men on board, twenty-eight electricians and eight wireless operators were necessary to handle the equipment.

The problem of securing trained men competent to take command of engineering reserves is of utmost consequence, and until the consulting engineers who are versed in modern practice are ready to give their assistance to an army desirous of securing it, but little can be done. When such assistance is sought and offered, our army will be reinforced by the strongest element in modern warefare—engineering skill.

METAL LAMPS.

The different manufacturers of metal-filament lamps have adopted various designations for the lamps which they put upon the market, and naturally when speaking of these to the trade they prefer to use such trade names in order to keep prominently in mind the distinctions as to the source of their products. When such lamps are spoken of as an entire class it is necessary, however, to have a comprehensive name which shall include all makes. The terms "metal-filament lamp," and "metallic-filament lamp" have consequently had wide use.

An editorial writer in the London *Electrician* makes the plea that either of these names is too long, and that, especially in dealing with the general public, some more concise yet equally descriptive designation should be employed. He therefore suggests the term "metal lamps." At first sight this term may not seem sufficiently descriptive, since it might also be applied to a brass lamp burning oil and a variety of other common forms of equipment. When understood, however, to mean a form of incandescent electric lamp, it seems sufficient, since it discriminates between the metal-filament lamps and those using carbon filament or Nernst glowers.

It has become customary to use the terms carbon lamp, tantalum lamp, etc., in place of the more cumbersome terms, carbon-filament lamp, tantalum-filament lamp, etc., and there seems to be no reason why the entire group of tantalum, tungsten, osmium lamps, etc., should not be designated as metal lamps. No confusion has resulted from mistakenly taking "carbon lamp" to mean an arc lamp, although the latter may use carbon as the active material. General use and the historical association of ideas seem to govern in such matters.

This use of the term "metal lamp" seems entirely practical and logical and the term supplies a desirable means of designating this class of lamps briefly and without loss of precision. We therefore commend it to our readers.

MATHEMATICS AND THE ENGINEER.

The work of many engineers lies along lines in which the principles are well established, and it is only necessary to apply these principles to the small variations of conditions which arise in the individual pieces of work which come to their hands. The work is often of a character which falls into the category of a regular routine, and the new features of design or estimation or arrangement required, while perhaps requiring the application of fundamental principles, of judgment arising from past experience, or of other knowledge which is at the command of the trained engineer, does not require any new application of theory or any quantitative investigation into the relationships involved which necessitates the use of any mathematics higher than ordinary arithmetic. Many practical engineers find their work, and that of many of their associates, so entirely confined within such limits that they doubt the necessity of any ability in the engineer to make use of the higher mathematics. When new problems have arisen in their work, they have found it possible to solve them by cut-and-try methods, or by copying the procedure followed elsewhere. This opinion is likely to be held all the more strongly when cases have arisen in the engineer's experience in which mathematical help has been admittedly of no service and practical experiment has had to be relied upon for overcoming the difficulty.

It hardly admits of an argument, however, that the engineer with mathematical ability has an additional tool at his command which his associate without such ability must lack, and that in the long run this must be an advantage. The current literature teems with mathematical investigations, and while the reader may be able to assimilate the conclusions reached without following every step in the discussion, he is, if mathematically untrained, usually unable to grasp the full significance of the investigation, to criticize it, or to realize how far the result may depend upon some arbitrary assumptions made at the outset.

But what is of more importance to the engineer than the ability to follow through a mathematical deduction, or even to carry out mathematical operations himself, is a firm grasp of the principles involved in mathematical processes. Too often we see the ability to carry out the mathematical operations without a proper conception of what the operations signify. Perhaps one of the most common faults of this kind is a confusion of partial and total differentials; another is a failure to recognize the limitations of the result obtained. Too much importance is usually attached to the algebraic and numerical side of the business, as applied in carrying on computations, and too little attention given to the interpretation of the mathematical process and result.

The remedy for such a state of affairs among engineers, and it is only too wide-spread, lies with our colleges and technical schools, since only a very small per cent of our engineers ever learn any mathematics outside of the schools. There is now a movement under way among teachers of engineering and mathematics to outline a course and prepare a textbook on mathematics which shall provide for the student of engineering the proper training in this important branch. It has been widely realized that present conditions are wofully unsatisfactory. It is to be hoped that improvements in this direction will be rapid and wide. Too much attention cannot be given to ensuring a thorough understanding of the principles and the fundamentals. A mere knowledge of the processes, without these, leaves the engineer with little ability to interpret, to criticize, or to carry out any original investigation in a wholly untried field.

ELECTRIC STREET LIGHTING.

The rapidity with which electrical science has been applied to the useful arts and the radical changes that have taken place in this adaptation of electricity to the service of man have frequently prevented the choice of a broad perspective for the outlook over the progress that has been achieved. This has even been true of the oldest branch of the supply of electricity from central stations, that for street lighting. Until within the last few years little attention has been given to providing a lighting that shall suit the actual illumination requirements that are met in various streets. The rapid development of illuminating engineering in recent years, as well as the perfection of a considerable number of new types of electric lamps, has opened new problems in street lighting, the solution of which presupposes a broad knowledge of the entire subject. Relatively little of what has been written on this topic has taken cognizance of more than a few features of it.

It is fortunate, therefore, that we are able to present in another part of this issue the first of a series of articles on this subject, which, while pithy, are yet broad in their scope. Their author, Mr. Albert Scheible, needs no introduction to the readers of technical journals. He is well known as one of the progressive and versatile engineers of the Central West. His experience as an illuminating engineer has been largely with street-lighting problems, which with his attractive style as an author makes these articles peculiarly interesting.

Mr. Scheible's articles will cover a historical review of street lighting, the application of the numerous types of electric lamps for this service, with a candid statement of the advantages and shortcomings of each, a study of the illumination requirements for different classes of street lighting, including ornamental and display lighting, a summary of the advantages of electricity over gas, and a résumé of the marked tendences in street lighting with a fair criticism of them. To all directly or remotely concerned with the proper lighting of our streets this series of articles will be of interest and value.

Convention of Foundrymen.

The American Foundrymen's Association, American Brass Founders' Association and the Associated Foundry Foremen will hold their annual conventions in Pittsburg, at the Exposition Building, on May 23 to 26, inclusive, 1911, and a general invitation is extended to all those interested.

The Foundry & Machine Exhibition Company will spare no expense to make their exhibit more complete than any other held on this continent. They have arranged not only to practically fill the large Exposition buildings, but will also erect an additional building on the grounds in which furnaces will be operated and the most up-to-date foundry machinery will be shown in operation and the best foundry supplies will be on exhibition.

Pittsburg Foundrymen's Association will entertain those attending the conventions, and has made special arrangements for the visiting ladies.

Papers on electric furnaces and on heating and lighting will be read at a joint session on May 24.

Utah Society of Engineers.

The regular monthly meeting of the Utah Society of Engineers was held in Salt Lake City on March 17.

A. S. Peters presented the paper of the evening, entitled "Protection at High-Tension Line Crossings."

Transportation Arrangements for National Electric Light Association Convention.

Charles H. Hodskinson, master of transportation of the National Electric Light Association, is already taking active steps to organize his important work in advance of the convention to be held in New York, May 29 to June 2. At the time of the St. Louis convention last year, when the membership was 5,500, the registered attendance was 2,780. The membership has now crossed the 7,100 line and will not be less than 7,500 at the time of the annual convention, so that on the same basis there will be from 3,500 to 4,000 present in registered attendance. This implies heavy transportation and Mr. Hodskinson has therefore formed the following active committee, which is taking up its duties in co-operation with Mr. Hodskinson. By the middle of April, practically all the details will have been arranged as to trips, rates, etc., and will then be announced. It is possible that other names may be added to the committee.

R. H. Ballard, Southern California Edison Company, Los Angeles, Cal.

W. J. Barker, Denver Gas and Electric Company, Denver, Colo.

E. J. Bowers, Kansas City Electric Light Company, Kansas City, Mo.

J. A. Britton, Pacific Gas & Electric Company, San Francisco, Cal.

F. A. Coupal, Buffalo General Electric Company, Buffalo, N. Y.

E. Creed, Toronto Electric Light Company, Toronto, Canada.

J. E. Davidson, Pacific Power and Light Company, Portland, Ore.

P. Doty, St. Paul Gas Light Company, St. Paul, Minn.

J. B. Eaton, Rochester Railway and Light Company, Rochester, N. Y.

G. A. Freeman, Commonwealth Edison Company, Chicago, Ill.

F. H. Gale, General Electric Company, Schenectady, N. Y.

A. F. Giles, General Electric Company, Atlanta, Ga.

W. J. Grambs, Seattle Electric Company, Seattle, Wash.

M. S. Hart, Consumers Electric Light and Power Company, New Orleans, La.

H. A. Holdredge, Omaha Electric Light & Power Company, Omaha, Neb.

H. M. Hope, Stone & Webster Corporation, Boston, Mass.

F. N. Jewett, Wagner Electric Manufacturing Company, St. Louis, Mo.

A. H. Manwaring, Philadelphia Electric Company, Philadelphia, Pa.

A. Maughan, Utah Light & Railway Company, Salt Lake City, Utah.

J. C. McQuiston, Westinghouse Bureau of Publicity, East Pittsburg, Pa.

A. A. Serva, Fort Wayne Electric Works, Fort Wayne, Ind.

Merriam Electric Club.

Following the announcement printed in last week's issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of the organization of the Merriam Electric Club, it was discovered that in making up the list of the executive committee several gentlemen's names were used without their authorization. They naturally objected to this and a communication has been sent from headquarters of the Merriam Electric Club requesting all members of the committee who have received stationery with these names printed upon them to consign this material to the waste basket.

Electric Furnaces at the University of Illinois.

There have recently been installed at the University of Illinois, through the combined efforts of the Department of Electrical Engineering, the Engineering Experiment Station and the Department of Chemistry, two electric furnaces. One of these is a Hoskins resistance furnace and the other a Colby induction furnace. Both are of twenty-kilowatt capacity. The furnaces will be used for the purpose of studying the changes that can be brought about in the mechanical and physical characteristics of cast iron through the influence of the soaking process which it is possible to maintain.

Engineering Building for University of Florida.

A contract has been let for the erection of the first portion of an engineering building for the University of Florida. This part provides for class rooms, drafting rooms, dynamo laboratory, steam laboratory, testing laboratory and hydraulic laboratory, and is to cost $40,000, exclusive of equipment.

It is expected that additional parts of the building, in the shape of wings adjoining the first part, will be built in the future as needed; and the plans have been worked out with special reference to development of this kind.

Michigan & Indiana Electric Company Dinner.

The Michigan & Indiana Electric Company recently gave a dinner at South Bend, Ind., to its superintendents, officers, foremen and a number of electrical contractors employed by the company at its several stations at Elkhart, Mishawaka, South Bend, Berrien Springs, Niles and Buchanan, which supply the St. Joseph valley with power and light. In the course of his address F. A. Bryan, manager of the company, advocated a utility commission such as are in vogue in New York, Wisconsin and Massachusetts for Indiana and hoped that some day it would be possible to have one.

New Wireless Station for Navy.

A wireless station capable of communicating with vessels at a distance of 2,000, or possibly 3,000 miles will be erected at Fort Myer, just outside of Washington, D. C.

William Stanley.

In the development of the alternating-current system of generating and distributing electrical energy, the electrical industry received its greatest impetus. Following the very rapid expansions of electrical adaptation which followed the successful development of continuous-current apparatus, for years the inventors and men of genius cast about for some means of economically transmitting electrical energy to extended areas. With the evolution of the alternating-current system the problem of distribution began its solution.

It is a peculiarity of the history of this development that although many workers had given their attention to the problem, the final solution which appeared worthy of extensive experiment and trial was contributed to by but a few workers. Very prominent among those to whose genius we are indebted for the solution of alternating-current generating and transmission is the subject of this sketch, William Stanley.

William Stanley was born in Brooklyn, N. Y., November 22, 1858, the son of William and Elizabeth A. (Parsons) Stanley. He was educated at the Williston Seminary at East Hampton, Mass., was in Yale with the class of 1881, but insofar as electrical science is concerned, he is a self-educated man.

Mr. Stanley was engaged in the nickel-plating business in 1879, in New York City, when he became acquainted with Hiram Maxim, now Sir Hiram, and he says himself that the personality of the latter so impressed him that he disposed of his nickel-plating business and engaged with Mr. Maxim as an assistant. In those days Mr. Maxim was one of the foremost electrical engineers in the country and was the founder and chief engineer of the United States Electric Light Company of New York City. After a short apprenticeship, Mr. Stanley became principal assistant to Mr. Maxim and in that capacity had charge of the general development of such new work as the company undertook. Mr. Maxim left the United States for the Paris Exposition in 1881 and Mr. Stanley resigned from the company and was engaged as an assistant to Edward Weston, with the old Weston Electric Light Company, at Newark, N. J.

In 1882, Mr. Stanley became connected with the Swan Electric Light Company, remaining with this company for about a year, during which time he invented and perfected a method of exhausting incandescent-lamp bulbs. During 1883 and 1884 he conducted a private laboratory at Englewood, N. J., devoting himself to experimental work on storage batteries and other inventive and manufacturing propositions.

WILLIAM STANLEY,
Electrical Inventor and Consulting Engineer.

It was in 1884 that Mr. Stanley became acquainted with George Westinghouse, who was at that time president of the Westinghouse Air Brake Company and of the Union Switch & Signal Company, and of other enterprises. A contract was made by which Stanley was to devote his time to the development of certain lines of investigation which he was interested in, and in case they were brought to a successful issue, Mr. Westinghouse agreed to promote them as a business enterprise and give Stanley an interest as a reward for his labors.

During this year Mr. Stanley installed and equipped a lamp factory for the manufacture of incandescent lamps at Swissvale, Pa., designed some continuous-current machines adapted to operate incandescent lamps, and was generally occupied with a system for this line of work.

It was about this time when very strenuous efforts were being made to devise some method by which electricity could be publicly served over more extensive areas than was possible with the systems then in use. Mr. Stanley began to investigate this subject and determined to devote his energies largely to an endeavor to solve this problem. In 1883 and 1884 he worked at an attempt to devise a general system of distribution employing alternating currents, and in 1885, while at Pittsburg, he began to have a very definite idea as to the methods of operation of induction coils energized by alternating currents, and conceived of the controlling actions and governing properties of the counter-electromotive force of induction coils.

In the spring of 1885, Mr. Stanley was taken ill and removed to Great Barrington, Mass. While recovering there he studied more ardently the problem of alternating-current distribution, and having worked out a coherent system he submitted the plans to a number of friends and to Mr. Westinghouse, but failed to secure the indorsement he had hoped for. He finally made up his mind to employ his own money for the construction of a plant which would demonstrate the value of this work. He rented a disused rubber mill at Great Barrington, engaged several assistants and ultimately developed what became known to the scientific world

as the Great Barrington plant at which alternating currents at 500 volts were generated and distributed in the town of Great Barrington through the medium of transformers connected in multiple. The success of this initial installation attracted electrical engineers and investors who visited the plant in May of 1886, in numbers. The Westinghouse Companies, realizing the value of the system devised by Mr. Stanley, took steps immediately for the development of the manufacturing details required for the production of Mr. Stanley's apparatus. The great electrical achievements that soon followed at Niagara Falls were largely contributed to by Stanley's inventions.

In the winter of 1890 and 1891, Mr. Stanley organized the Stanley Electric Manufacturing Company at Pittsfield, Mass., for the purpose of making electrical apparatus embodying his ideas. His associates in this enterprise were John F. Kelly and C. C. Chesney, and the immediate result of this organization was the famous S. K. C. apparatus. The first successful Stanley motors were completed early in the summer of 1892, and in 1894 the company installed the multiphase transmission system at Housatonic, Mass., operating at 2,000 volts and employing the radically new ideas involved in Mr. Stanley's apparatus. This installation was followed by many others of a similar character employing high voltages and led to a rapid introduction of this method of generation and distribution.

Later on Mr. Stanley organized the Stanley Instrument Company for the manufacture of a new form of wattmeter and for several years devoted his energies almost entirely to the development of this enterprise.

For some time Mr. Stanley has been engaged in a consulting capacity for a number of strong interests and at the present time he is at work on a very important line of research development, a chronicle of which must await the further working out of lines which have been well established and which point to a most important ultimate result in the conserving of energy through the generation and storage of electricity.

Convention on Engineering Education.

The nineteenth annual meeting of the Society for the Promotion of Engineering Education will be held in Pittsburg, Pa., June 26, 27 and 28. Headquarters for the convention will be at the Carnegie Technical Schools.

Dr. Spitzka Lectures to Philadelphia Section.

The regular monthly meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held on March 20. Edward Anthony Spitzka was the speaker of the evening.

Dr. Spitzka is professor of general anatomy in the Jefferson Medical College and is an authority on the anatomy and function of the nervous system. His contributions to scientific bodies on this subject are known throughout the world. Dr. Spitzka is also a student of the action of electricity on the human body and has conducted exhaustive experiments on the changes produced in the body by electricity. He is a strong advocate of electrocution.

Dr. Spitzka covered in his lecture the full range of the effects of electricity on the human body, from the effects of lightning to the usual current used for industrial and residential purposes. He brought out many new and interesting discoveries regarding the effect of electricity on the human system, which were fully illustrated by lantern slides. Dr. Spitzka gave many interesting experiences, based on his own investigation of some fifty-seven electrocutions in the various States in which electrocution is used as a means for capital punishment. In the majority of these cases Dr. Spitzka had made post-mortem examinations. Of interest was the statement that the temperature of the body in many instances was raised as high as 129 degrees Fahrenheit immediately after electrocution.

Regarding accidents which may occur in the commercial use of electricity, many slides were shown of various types of electric burns, their history stated, and various methods of practicing artificial respiration, which would in the majority of cases save the life of the injured, were explained.

The lecture was discussed by many prominent physicians and they were unanimous in their praise of the splendid work that is being done by Dr. Spitzka in this particular field, and the benefit which will naturally result in the saving of life. The discussion was also entered into by many prominent electrical engineers, among them Percy H. Thomas and W. C. L. Eglin, who asked pertinent questions from the practical standpoint, all of which were ably answered by Dr. Spitzka.

Prior to the meeting an informal dinner was held, at which all the out-of-town visitors were entertained, the table being spread for fifty covers. The table was beautifully decorated with festoons of electric flowers, an electric fountain and baskets of flowers illuminated by miniature electric lamps. The usual Philadelphia hospitality was very conspicuously shown.

The best evidence of the interest taken in the lecture is the fact that there were over four hundred in attendance and at least one hundred turned away.

American Mining Congress Will Meet in Chicago.

The American Mining Congress has selected Chicago as the meeting place for the 1911 convention, which will be the fourteenth annual meeting of this body. The date of the meeting has not been determined, but it will probably be in October.

Among the questions which will be discussed at the Chicago meeting are a workmen's compensation law, the general revision of mineral land laws, and the standardization of electrical equipment in coal and metal mines. The American Mining Congress has had committees at work upon these questions for several years.

At the Los Angeles session of the Mining Congress, held last October, a committee of mine operators and electrical engineers reported a code of rules for the standardization of electrical practice in coal mines, while another committee made a most valued report on the prevention of mine accidents. Both these reports have been published in the *Proceedings* of the Mining Congress.

The committee on standardization of electrical equipment will make another report to the Chicago meeting, embodying such additions to its last report as are suggested by recent discussions on the subject. The membership of the committee is as follows: Samuel A. Taylor, Pittsburg, Pa., chairman; J. R. Bent, Oglesby, Ill.; G. A. Schreier, Divernon, Ill.; Harry M. Warren, Scranton, Pa.; Geo. T. Watson, Fairmont, W. Va.; George R. Wood, Pittsburg, Pa.; W. A. Thomas, Pittsburg, Pa.

The Power System of the Southern California Edison Company—II.

The Lytle Creek and Kern River Stations.

BY W. B. GUMP.

LYTLE CREEK STATION.

The Lytle Creek station (Fig. 11) is the smallest of the hydroelectric plants of this company. It was installed in August, 1904, and is located forty-six miles from Los Angeles, being used to transmit power to Colton substation, over a 11,000-volt transmission line.

The capacity of this plant is 500 kilowatts, which is furnished by two General Electric, 250-kilowatt, three-phase, 11,000-volt generators, operating at 375 revolutions per minute. The head is 483 feet. Pelton wheels are used, each wheel having eighteen buckets. Two exciters, separately driven, furnish field current.

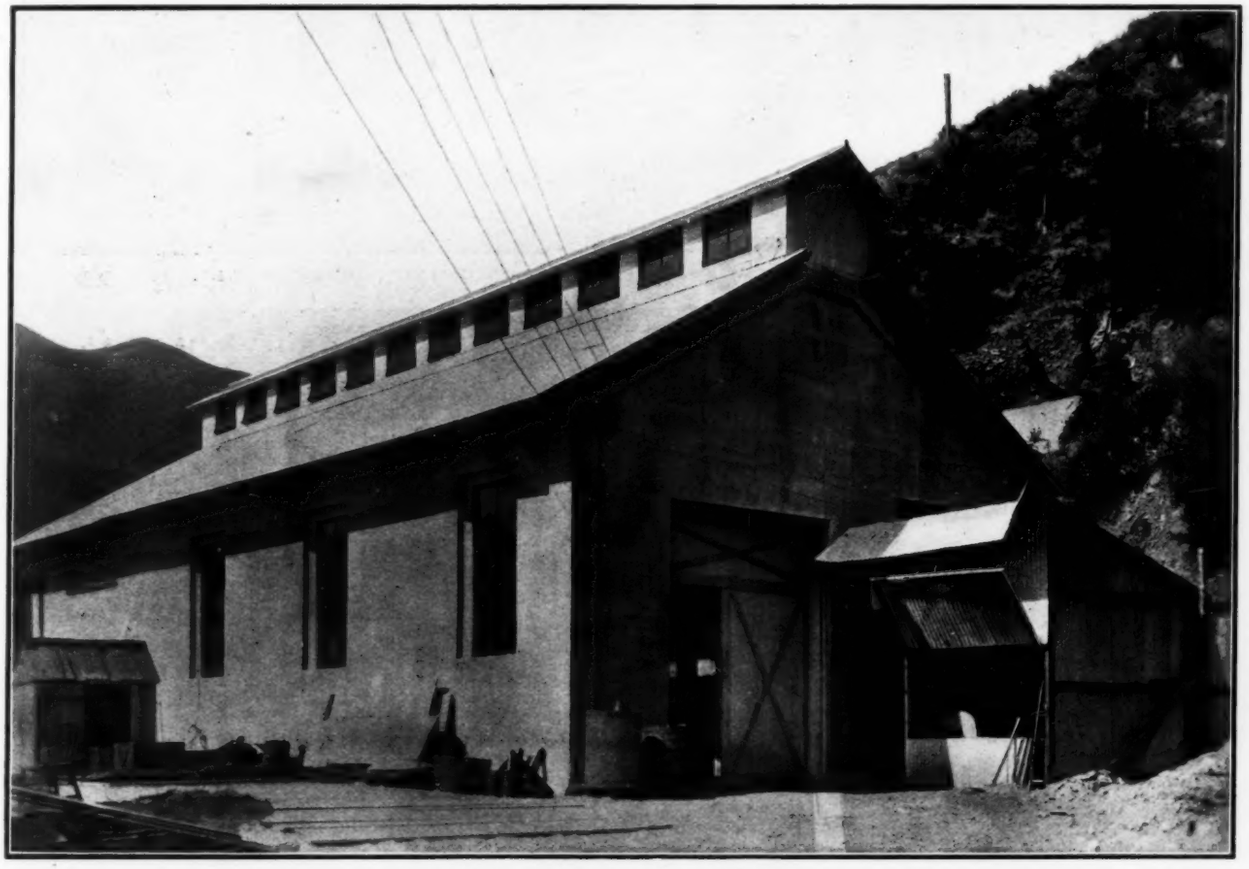


FIG. 11.—LYTLE CREEK STATION.

DWELLINGS AND ACCOMMODATIONS FOR EMPLOYEES.

The importance of first-class accommodations for operators, and workmen, in connection with hydroelectric plants, as in other plants, is not always appreciated. In the case of the Southern California Edison Company this matter has been carefully considered, and those having occasion to visit those plants will find this statement corroborated. Visitors to these plants are cared for, as is the weary traveler who must finally turn to a resting place in the midst of his journeys.

Each power plant is so situated that the topography, and the environment as well, favor the planting of trees, shrubs, and the beautifying of lawns and gardens. In this way, the men are something more than machines, and they soon demonstrate their appreciation of the treatment received by returning creditable work in which the element of personal interest has a leading place. Upon questioning the families of these men one will find that they live a peaceable and contented life, though more secluded than would be desired by some.

THE KERN RIVER NO. 1 PLANT.

The foregoing description has embraced the hydroelectric generating equipment of the Edison Company's system, with the exception of one plant, the largest of the system. This is known as Kern River No. 1, being the latest acquisition, and possessing certain characteristics not found in other plants, a detailed description of its principal features will therefore be justified.

The Kern River project comprises the development of power in Kern County, at a point in the Kern River about a half mile below Democrat

Springs. From this point water is diverted to a water-conducting system, embracing flumes and tunnels to the extent of eight miles. At a point just opposite the intake of the Bakersfield Power, Transit & Light Company, and at an elevation approximately of 900 feet, water from the flume line is let into a forebay from which a pipe line conducts it to the plant situated in the canyon below. The discharge water leaves the plant at a point just above the Bakersfield Company's intake, so as not to interfere with the latter in any way.

HEAD WORKS.

The head works of the Kern River project consist essentially of a diverting dam and intake, Fig. 14. The tunnel is widened at the intake for two reasons: to accommodate the screen area required, and also to prevent the contraction of the water entering the tunnel. The head-gates are operated by means of hydraulic cylinders.

There is a sluicing tunnel used to expel silt and sand which collects above the dam. The portion of water just above the dam is, in a sense, a settling basin, and should be as free from sediment as possible before entering the conducting system.

The entrance to the tunnel is provided with a heavy grizzly, consisting of seventy-pound T-rails. This insures the tunnel against any accumulation of branches, sticks or other floating debris large enough to do harm at the forebay.

There are in all nineteen gravity tunnels. The design of tunnel section is a compromise between that most efficient for the highest velocity for minimum slope, and that best adapted to support decomposed granite, and other loose formation. Its section in the rough was made nine feet in width by seven and one-half in height, from bottom to spring line of the arch. A lining of concrete six inches thick was applied, having a net section eight feet wide by seven feet high.

The grade of the tunnels is 7.92 feet per mile, with the object of carrying water to a depth of six and one-half feet. The area of cross-section is fifty-two square feet, the wet perimeter twenty-one feet, and the mean hydraulic radius 2.5 feet. With an assumed coefficient of roughness of 0.012 as applied to Kutter's formula, the discharge becomes approximately 470 cubic feet per second.

The arching of the tunnel was necessary only where the earth above needed rigid support. Less than fifteen per cent of the tunnel work required arching.

TIMBER FLUMES.

In planning wooden flumes the intention was to avoid, or at least minimize, the flumes spanning ravines. A few of these were necessary, however, in order to shorten the water conductor. These flumes (Fig. 12) are in all cases placed upon concrete foundations, and are designed with a factor of safety which should give them a life of from thirty to forty years. The flume box is of three-inch redwood planks obtained from butt ends of Sequoia Sempervirens, which grows in swamps in Northern California west of the Coast Range. The frame work for supporting the flume box is of Oregon pine, and is so designed that no part of it becomes exposed to the earth or to drippings from the flume, should it spring a leak. In this way the life of the supporting frame is greatly increased. As for the redwood flume itself, nothing is lacking which could make it more permanent. A great many years of service of similar flumes has shown that redwood is practically indestructible, as far as rotting and deterioration is concerned.

FIG. 12.—A SECTION OF FLUME, KERN RIVER.

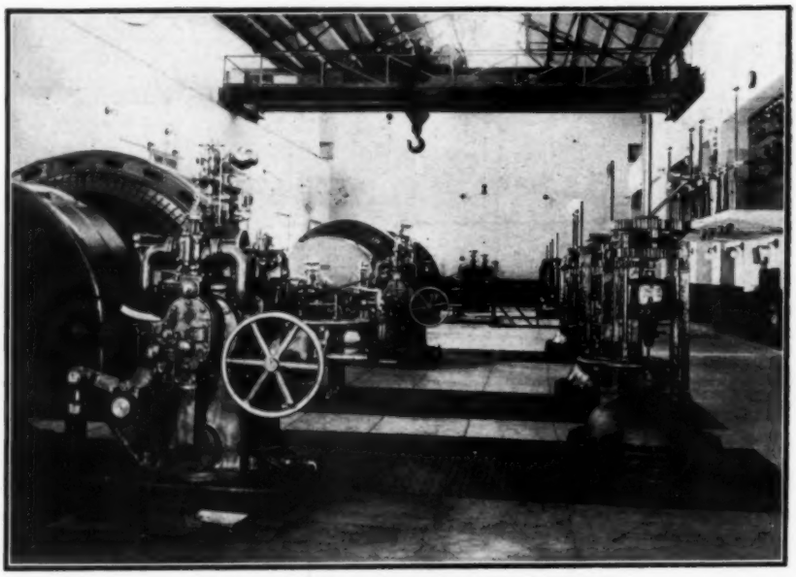


FIG. 13.—INTERIOR OF KERN RIVER PLANT.

Between tunnels No. 6 and No. 7 the flume is constructed of structural steel

and concrete. The entire structure is carried upon I-beams, which rest upon concrete piers. The construction of this flume consists of expanded metal held in place by the frame work, and plastered with concrete. It is of a sectangular section, and while more costly than the wood construction is more permanent.

FIG. 14.—DIVERTING DAM AND INTAKE.

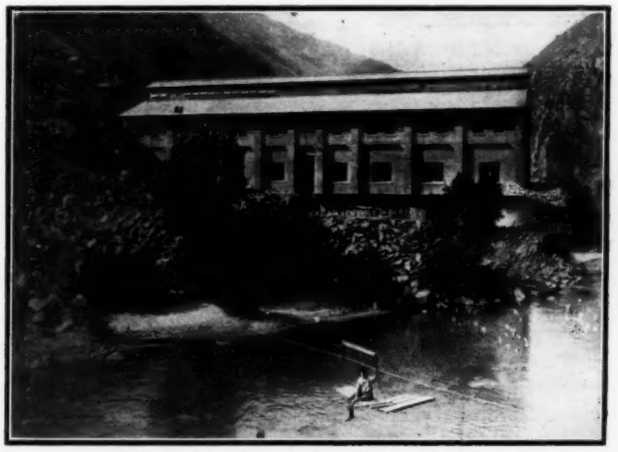


FIG. 15.—KERN RIVER PLANT, LOOKING DOWN STREAM.

THE PRESSURE MAIN.

The pressure pipe is constructed of steel, and is nine feet in diameter at the forebay, tapering to six and one-half feet at a distance of twenty feet from the nine-foot end. The tunnel for this pipe was driven with a circular section nine feet in diameter. A plank spillway extends from the forebay to the canyon below, to a point up stream, a little beyond the power house.

The low end of the pressure pipe proper is five and one-fourth feet where it enters the header from which the nozzles are fed. This section is constructed of one-and-one-eighth-inch steel plate, butt riveted, the entire pipe being designed to stand without external support. The pipe tapers from five and one-fourth feet to twenty-eight inches. The tapers on the lower end of the pressure pipe, to which branch pipes are connected, are as follows:

33.5	feet	4¾	feet	pipe
23	"	4¼	"	"
21	"	3¾	"	"
11.5	"	3	"	"
16.7	"	2⅛	"	"

These diameters were graduated to make the velocity uniform for all wheels. Tapers were fitted as follows:

1	Taper	7.5	feet	diameter	to	5.25	feet	diameter,	20 feet long
"		5.25	"	"	"	4.75	"	"	10 " "
"		4.75	"	"	"	4.25	"	"	10 " "
"		4.25	"	"	"	3.75	"	"	10 " "
"		3.75	"	"	"	3.00	"	"	10 " "
"		3.00	"	"	"	2.33	"	"	10 " "

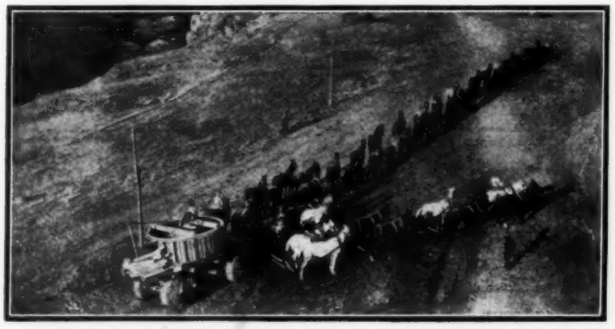


FIG. 16.—FORTY-EIGHT-HORSE TEAM TRANSPORTING MACHINERY TO KERN RIVER PLANT.

FIG. 17.—KERN RIVER PLANT, AS SEEN FROM THE FOREBAY.

The branch pipes are connected to the leader by means of Y-connections. In each branch pipe leading to a nozzle there are two twenty-eight-inch valves; one outside the power house, and the other inside. Figs. 15, 16 and 17 give some idea of the appearance of the power plant and the topography of the site.

WATER WHEELS.

There are two water wheels directly connected to each generator. The effective head is 875 feet, and the nozzle stream is seven and one-fourth inches in diameter. Each pair of wheels is rated at 10,750 mechanical horsepower to be delivered to the shaft. Each wheel contains eighteen bronze buckets, twenty-seven and one-half inches wide, which drive the wheels at a speed of 250 revolutions per minute.

The moment of inertia of the revolving element is 1,800,000 foot-(squared)-pounds, by means of which regulation at 100 per cent load variation is obtained within eight per cent, under fifty per cent overload, and less than five and one-third per cent under normal load.

GOVERNORS.

Each pair of wheels is regulated by a self-contained oil-actuated Escher-Wyss governor. These governors have their pumps immersed in the oil reservoir. Governing is accomplished by deflecting the nozzle, without altering the shape of the stream at the opening. The nozzle is bifurcated, so as to counteract side thrust and an immense strain at the ball joint. The nozzle

stream is seven and one-fourth inches in diameter and discharges from a ten-and-three-eighths-inch opening.

MAIN BEARINGS.

The generators are each carried on two sixteen-inch by forty-eight-inch babbitted bearings, each fitted with six oil rings for flooding the bearings from the cellars contained in the pedestals. The oil is cooled by means of water-cooling coils carried within.

GENERATORS.

Each of the four generators is of the stationary-armature type, rated at 5,000 kilowatts, and having an overload capacity of fifty per cent for two hours. The armature is bar wound for 2,300 volts normal potential, at a frequency of fifty cycles.

EXCITERS.

There are two exciters rated at 225 kilowatts. These are flat-compounded to give 125 volts at a speed of 430 revolutions per minute.

TRANSFORMERS.

There are thirteen single-phase transformers, each rated at 1,667 kilowatts. Thus, one of these is used as a reserve, and stands ready to be interchanged with any of the others, there being four groups of three each. The transformers are of the oil-filled, oil-circulating type, contained in boiler-shell casings. They are installed in alcoves just off the generator room, into which the high-tension leads extend. The oil within these transformers has natural circulation to a receiving drum, from which it is forced by pumping into coolers placed in the tail race. The general construction of the coolers resembles that of a surface condenser, of the evaporative type.

These transformers receive energy at 2,300 volts, and transmit it to the line at 75,000 volts. Taps are also provided for 56,250 volts and 37,500 volts, respectively. Their primaries are delta and their secondaries star-connected. The practice of grounding the neutral has been carried on throughout the company's system.

HIGH-TENSION WIRING.

The leads from the generators are carried in ducts to the 2,300-volt oil-switches, which are located in the basement. The secondary, or high-tension wiring, is carried in compartments, according to standard practice.

Observing the wiring diagram (Fig. 18) it will be seen that there are but two busses: one low-tension, and one high-tension. These may be sectionalized so that the load may be separated between individual machines.

SWITCHBOARD EQUIPMENT.

The switchboard is located on a gallery overlooking the central portion of the plant (Fig. 13). Instruments used are: three indicating ammeters, one indicating voltmeter, one curve-tracing wattmeter, one recording watt-hour meter, one curve-tracing voltmeter, and one curve-tracing ammeter, for each generator panel respectively. There are eleven panels, of which six are located near the front of the gallery. The generator field panels, and totalizing panels, are located at the rear and facing in opposite direction.

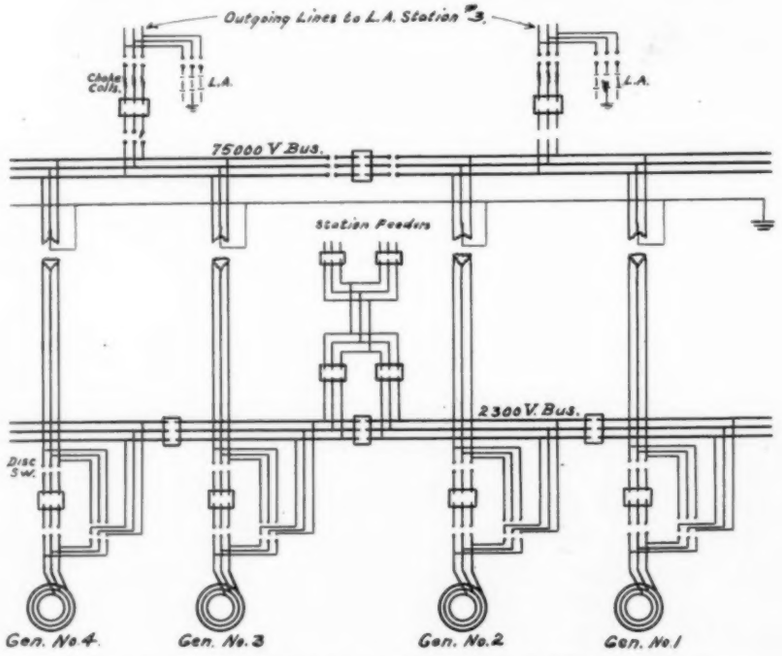


FIG. 18.—WIRING DIAGRAM OF KERN RIVER STATION NO. 1.

The generator field rheostats are hand operated by means of gearing. A fifty-ton electric crane spans the generator room.

TRANSMISSION LINE.

The transmission line is carried on steel towers, of which there are 1,013. These range in height from forty to sixty feet. The total length of line is 117 miles, making the average span 700 feet. The conductors are of No. 0000 copper, which is made up of seven strands. Spacing between conductors is six feet.

There are two three-phase lines extending to Los Angeles, both of these lines sharing the load under normal conditions. At several places in the canyons, the stringing of line conductors is very difficult, and at such points there are three three-phase lines; that is, nine conductors, instead of six, affording a reserve section.

It was originally intended that these towers were to take the transmission line from the plant proposed for a future development, and the towers were designed accordingly. Emergencies of a varied sort have shown that a second line adds to the service to an extent which warrants the use of the entire tower.

The insulators are of the triple-petticoat, gray-porcelain type, supported on iron pins, and weighing when assembled about fifty pounds each without the pin. One of these insulators measures eighteen inches across the upper petticoat. The transmission line is intercepted at three points by switching stations; one at Tejon, one at Castaic, and one at Fernando (Fig. 19). By means of these switching stations any portion of the line may be cut out of service, and a reserve section of line substituted. It should be stated here that no transpositions are made on this line. The Kern River transmission terminates at Los Angeles (Fig. 20), where it feeds into steam station No. 3, to be described later.

THE TELEPHONE LINE.

A telephone line extends the full length of the transmission system, being

supported on the steel towers. The telephone line is transposed at every tower. Considerable difficulty was experienced in balancing the telephone system, and the scheme adopted was to install 2,000 110-volt transformers, connecting the high-tension side across the line at each instrument and grounding this coil at its middle point. The telephone line is sectionalized and is provided with switches, so that if any section is out, the instrument at the next section is protected by the interposition of a balancing transformer. That is, a section cannot be disconnected without switching a transformer into its proper position with the telephone instrument being used. The construction of the switch is simply that of a blade which recedes from one clip and enters into another connecting the transformer into the telephone circuit, as above mentioned.

It may be stated here that most of the interruptions on the transmission line have been caused by large birds. In a few cases the line conductors have been burned off, and service temporarily crippled. Everything considered, this line has given good service, and has been very reliable.

(To be continued.)

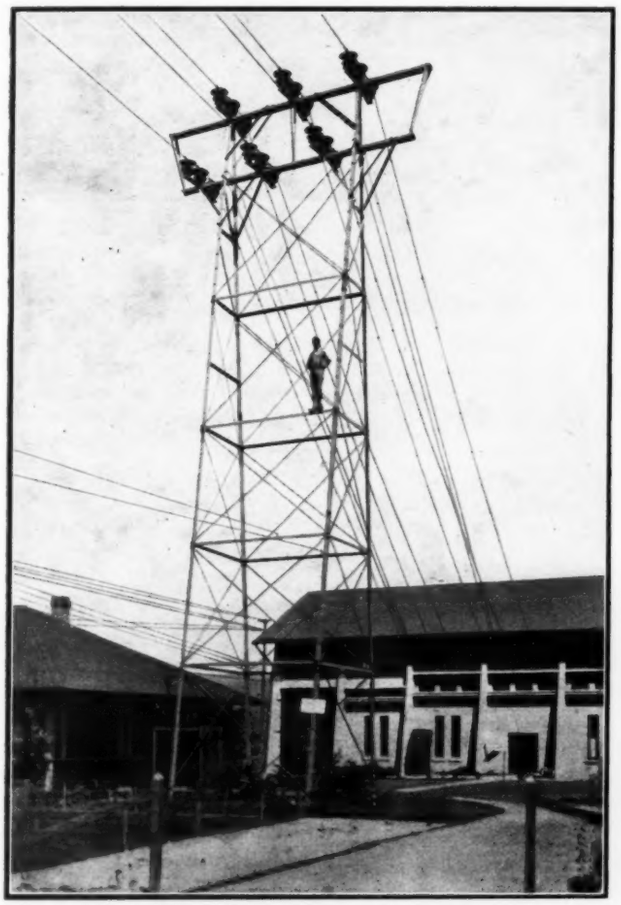


FIG. 19.—SWITCHNG STATION AT SAN FERNANDO.

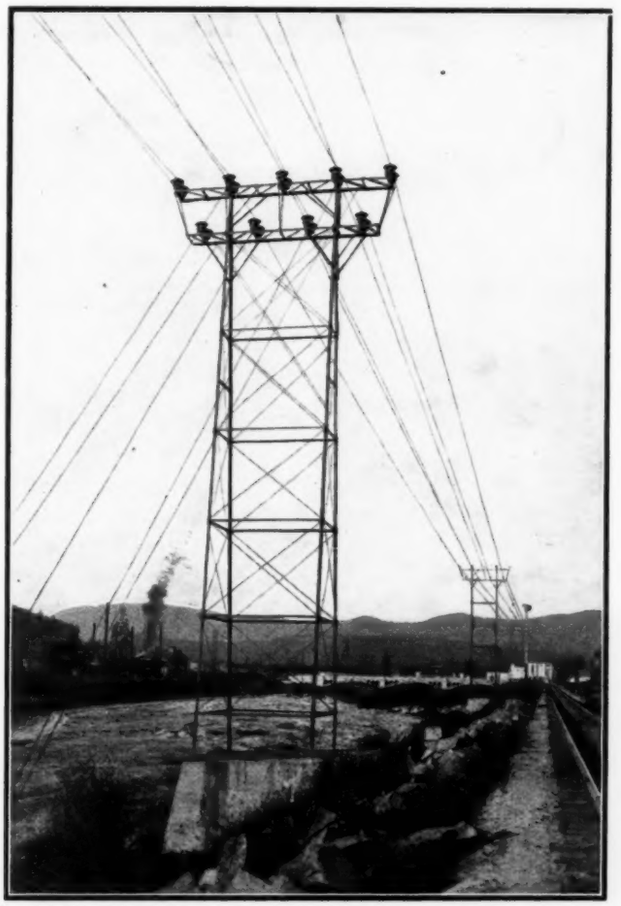


FIG. 20.—75,000-VOLT STEEL TOWERS NEAR LOS ANGELES.

Car Battery Company to Liquidate.

The Hopedale Electric Company, of Boston, Mass., which nearly a score of years ago operated street cars by electric storage batteries, is to liquidate its affairs and distribute among its eighty-four stockholders the $40,000 in its treasury.

In 1892 the Milford & Hopedale Electric Railroad was operating cars by the Usher storage battery. It was purchased by Edwin H. Abbott of Boston and others, who planned to operate a line between Boston and Cambridge.

Later the owners of the Brush Storage Battery, afterwards the Electric Storage Battery Company, began suit against the Hopedale company, and the litigation on patent rights dragged for some time.

Commercial Section, National Electric Light Association.

The climax of the nation-wide campaign for new members which is being waged by the Commercial Section of the National Electric Light Association will take place on Monday evening, June 1, at the Hotel Martinique, New York City, where a banquet will be tendered by George Williams and J. Robert Crouse to all who have had a part in this campaign. The main feature of the banquet will be the presentation of the sterling-silver loving-cup donated by Mr. Crouse to the person who succeeds in securing the largest number of new members.

It is announced that this contest for the cup will not cease until midnight of May 31. Each contestant's name, together with the number of members he has secured, will be posted in good readable type at one end of the banquet hall. All the committeemen of the Commercial Section have been enrolled *ex officio* as participants in the cup contest.

EFFECT UPON VOLTAGE OF AN ASYMMETRICAL ARRANGEMENT OF CONDUCTORS.

BY CASSIUS M. DAVIS.

If the conductors of a three-phase transmission line are not symmetrically arranged, that is, at the vertices of an equilateral triangle, the individual inductances, and hence the induced electromotive forces, will be unequal. This causes an inequality of voltages between the lines at the receiving end. It is for the purpose of determining the magnitude of this inequality that the following calculation is made.

Assume the conductors 1, 2 and 3, separated by distances D_1, D_2 and D_3

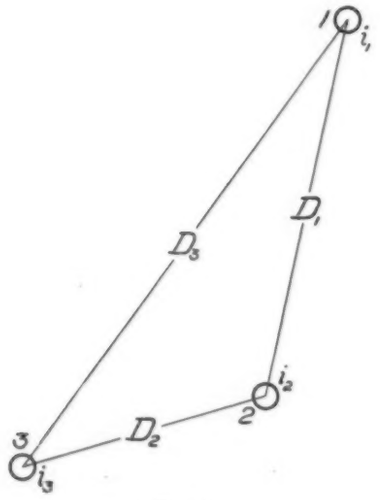


FIG. 1.

(Fig. 1), carrying the three-phase currents

$i_1 = I \sin 2\pi f t$

$i_2 = I \sin (2\pi f t - 2\pi/3)$

and

$i_3 = I \sin (2\pi f t - 4\pi/3)$

At any instant

$i_1 = -i_2 - i_3$

The inductance of conductor 1 is made up of two components, one due to the flux between conductors 1 and 2 and caused by, and interlinked with, that component of i_1 which returns over conductor 2, or i_2, and the other due to the flux between conductors 1 and 3 caused by, and interlinked with, that component of i_1 which returns over conductor 3, or i_3. Call these two components L_2 and L_3. They induce in conductor 1 two electromotive forces, e_2' and e_3', caused by the cutting of the flux surrounding conductor 1. They are:

$$e_2' = L_2 \frac{di_2}{dt}$$

and

$$e_3' = L_3 \frac{di_3}{dt}$$

Substituting for L_2 and L_3 their values, $x_2/2\pi f$ and $x_3/2\pi f$ and differentiating the above equation for $i_2$and i_3, we get

$e_2' = -x_2 I \cos (2\pi f t - 2\pi/3)$

and

$e_3' = -x_3 I \cos (2\pi f t - 4\pi/3)$

The total electromotive force induced in conductor 1 is the sum of e_2' and e_3', or,

$e_1 = I [-x_2 \cos (2\pi f t - 2\pi/3) - x_3 \cos (2\pi f t - 4\pi/3)]$

Expanding and putting $2\pi f t = \phi$,

$$e_1 = I \left(\frac{x_2 + x_3}{2} \cos \phi - \frac{x_2 - x_3}{2} \sqrt{3} \sin \phi\right)$$

Similarly, by rotating the values of i_1, i_2 and i_3,

$$e_2 = I \left(\frac{x_3 + x_1}{2} \cos \phi - \frac{x_3 - x_1}{2} \sqrt{3} \sin \phi\right)$$

$$e_3 = I \left(\frac{x_1 + x_2}{2} \cos \phi - \frac{x_1 - x_2}{2} \sqrt{3} \sin \phi\right)$$

Let the corresponding vector quantities be E_1, E_2 and E_3.

The induced electromotive forces thus consist of two components, one in quadrature with I, the electromotive force of self-induction, and one in phase with I, the electromotive force of mutual induction. The component in phase with I may be positive or negative, depending upon the relative values of the reactances; its value, however, is small, since it is the difference of two nearly equal quantities, but it cannot always be neglected.

Where the conductors of a three-phase line are placed at the vertices of an equilateral triangle no unbalancing occurs, since x_1, x_2 and x_3 are equal to each other, hence e_1, e_2 and e_3 are equal to each other, and the only effect is a slight difference of phase between the ends of the line. In this case the term representing mutual induction is zero.

Fig. 2 gives the vector diagram. $E_oE_oE_o$ are the three sides of an equilateral triangle representing the delta voltages at the generator on a balanced line. I is the current in one conductor bearing a certain phase relation, θ_o, to the voltage producing it. The induced electromotive force in conductor 1 is E_1, made up of the power component E_m (mutual induction), and the reactive component E_s (self-induction). Similarly the induced electromotive forces in the other conductors are E_2 and E_3. These when added to the vectors E_o distort the diagram to a scalene triangle whose sides are E', E'' and E''', and change the phase angle from θ_o to θ', but this change of phase may not be the same in all of the three phases. The ratio $E' : E'' : E'''$ is a measure of the unbalancing of the line.

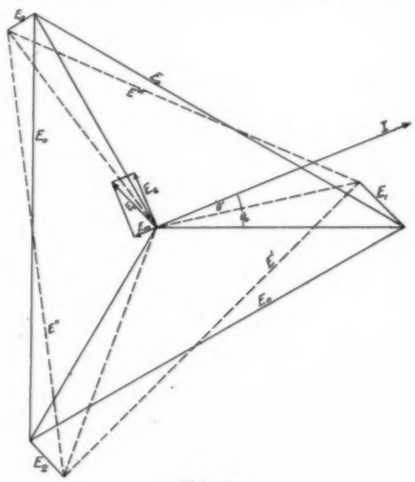


FIG. 2.

It is inconvenient on some transmission lines to place the conductors symmetrically, as for instance when two circuits are placed on the same towers. Lines have been constructed where the conductors are suspended one above the other in the same plane, or where they are placed at three corners of a square. A numerical problem is worked out under each case to show what inequality may exist.

Assume a transmission line sixty miles long of number 00 B & S wire delivering 200 amperes per conductor at a potential of 63,000 volts delta at the generator, and a frequency of sixty cycles. Assume in the first case that the conductors are arranged at three corners of a square six feet on a side, Fig. 3. Thus $D_1 = D_2 = 72$ inches, and $D_3 = \sqrt{2} \times 72 = 102$ inches.

Consider the electromotive force induced in conductor 1. $L_2 = 0.1203$ henry and $L_3 = 0.1269$ henry, then $x_2 = 2\pi f L_2 = 45.35$ ohms and $x_3 = 47.84$ ohms. These give:

$e_1 = 200 (46.60 \cos \phi + 1.25 \sin \phi)$.

Since the component representing mutual induction is small compared to the other component, and since it affects the vector sum and the phases of the induced electromotive forces only slightly, it may be neglected, then

$$e_1 = 9{,}320 \cos \phi.$$

The maximum value of the voltage of self-induction in conductor 1 is then, $E_1 = 9{,}320$ volts.

For conductor 2, $L_1 = L_3 = 0.1203$ henry and

$$e_2 = 200\ (45.35\ cos\ \phi)$$

the sine term disappearing. The maximum value is $E_2 = 9{,}070$ volts.

In conductor 3, e_3 would have the same value as e_1, but the sine term would be negative. This gives $E_3 = 9{,}320$ volts.

These values applied to Fig. 2 with $E_o = 63{,}000$ and $\theta_o = 18$ degrees give:

$E' = 60{,}200,$
$E'' = 59{,}980$ and
$E''' = 60{,}080$ volts.

The ratio of unbalancing is 60,200 : 59,980 : 60,080=1 : 0.996 : 0.998. That is, the unbalancing is negligible.

Take now the same transmission line, but with the conductors arranged as shown in Fig. 4. Here $D_1 = D_2 = 72$ inches, and $D_3 = 144$ inches.

For conductor 1, $L_2 = 0.1203$ henry and $L_3 = 0.1342$ henry, hence $x_2 = 45.35$ ohms, $x_3 = 50.60$ ohms, and

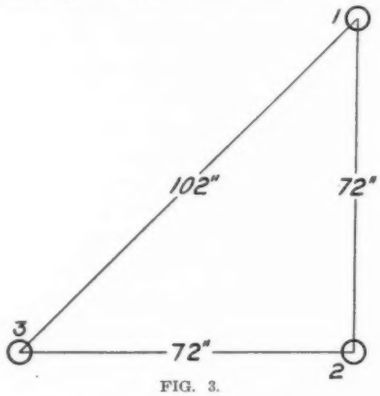


FIG. 3.

$$e_1 = 200\ (47.98\ cos\ \phi + 5.25\ sin\ \phi)$$

Here a large part of the effect is due to mutual induction and so it has been considered in the calculations. Its effect may be seen thus: neglecting mutual induction, the ratio of unbalancing comes out to be 1 :0.985 :0.988, while the ratio actually is 1 :0.961 :0.979. The difference arises from the fact that the terms for mutual induction affect the phases of E_1, E_2 and E_3, and a small change of phase may cause a considerable variation of E', E'' and E''', especially if two of the components of E_m should have the same sign.

The inductive drops are, maximum values:

$E_1 = 9{,}650,$
$E_2 = 9{,}070,$
$E_3 = 9{,}650.$

These values give:

$E' = 61{,}350,$
$E'' = 58{,}950,$
$E''' = 60{,}100.$

The ratio is 1 :0.961 :0.979 and the effect of asymmetry is still negligible.

Assume the extreme arrangement where $D_2 = 10D_1 = 60$ feet and $D_3 = 6 + 60 = 66$ feet $= 792$ inches, as might be the case of a line having two overhead conductors with ground return.

For conductor 1, $L_2 = 0.1203$ henry, $L_3 = 0.1668$ henry, giving $x_2 = 45.35$ ohms and $x_3 = 62.90$ ohms. From these

$$e_1 = 200\ (54.12\ cos\ \phi + 8.77\ sin\ \phi)$$

$E_1 = 10{,}960$ volts.

For conductor 2, $L_1 = 0.1203$ henry, $L_3 = 0.1644$ henry, $x_1 = 45.35$ ohms, $x_3 = 62.00$ ohms, and

$$e_2 = 200\ (53.67\ cos\ \phi - 8.32\ sin\ \phi)$$

$E_2 = 10{,}860$ volts.

For conductor 3, $L_2 = 0.1644$ henry,

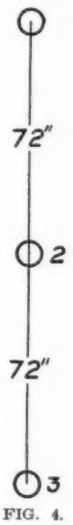


FIG. 4.

$L_1 = 0.1668$ henry, $x_2 = 62.00$ ohms, $x_1 = 62.90$ ohms, and

$$e_3 = 200\ (62.45\ cos\ \phi - 0.45\ sin\ \phi)$$

$E_3 = 12{,}490$ volts.

Solving the triangle,

$E' = 60{,}100,$
$E'' = 57{,}730,$
$E''' = 62{,}500$ volts.

The ratio is 0.962 : 0.924 : 1, or a maximum of only about eight per cent. This calculation includes the effect of mutual induction; neglecting it gives:

$E' = 60{,}050,$
$E'' = 59{,}200,$
$E''' = 60{,}900,$

with a ratio of 0.985 : 0.972 : 1. It is seen in this case that most of the unbalancing is caused by the effect of mutual induction.

The inequality of star voltages may be greater or less than that of delta voltages. The following are the values for each case as given above. Conductors at the corners of a square:

$E' = 34{,}610,$
$E'' = 34{,}720,$
$E''' = 34{,}720,$

and the ratio is 0.997 : 1 : 1.

Conductors suspended in the same plane, $D_1 = D_2$:

$E' = 35{,}700,$
$E'' = 34{,}720,$
$E''' = 33{,}620,$

the ratio is 1 : 0.973 : 0.943.

Same arrangement but $D_2 = 10\ D_1$:

$E' = 36{,}400,$
$E'' = 32{,}880,$
$E''' = 34{,}800,$

ratio 1 : 0.930 : 0.983.

From this discussion it is evident that only a small distortion of line voltage is produced by an asymmetrical arrangement of conductors. Thus it would seem that a very few transpositions of the line wires would reduce the inequalities to almost nothing.

Capacity has not been considered here. It causes an unbalancing but probably of less magnitude than that caused by inductance, since capacity causes an unbalancing of currents in the conductors and any inequality of voltages would arise as a secondary effect due to unequal currents.

Lighting Troubles in Toledo, Ohio.

The city of Toledo, O., is said to be at present facing a crisis in the matter of lighting and has in prospect continued litigation with the possible cutting off of electric service from 6,500 residences.

The lighting franchises held by the Toledo Railways & Light Company will expire during the coming summer, and an effort will be made to secure a reduction in the present rates, which effort is being resisted by the company on the ground that it is now furnishing current as low as is consistent with good business, and that to meet the demands made upon it would mean a practical confiscation of its property.

The present rate charged is nine cents per kilowatt-hour with a ten-per-cent discount and a minimum monthly charge of $1. At a recent meeting of the city council committee a schedule of six cents per kilowatt-hour was adopted, with a discount if paid within ten days of receipt of bill, and a minimum charge of fifty cents per month, thus reducing residence lighting to five cents per kilowatt-hour. The report was unanimously adopted by the com-

mittee. The company promptly notified the committee that it positively would not accept the rate, and suggested a commission of engineers to examine the company's books for a basis of negotiations. Notice was also given that if the council should ratify the report of the committee the company will bring suit to enjoin the city from putting the rate into effect on the ground that it is confiscatory. The company asserts that it is losing money on the nine-cent customers now, and that rather than furnish current cheaper it would discontinue this service.

Toledo was one of the first cities to adopt the underground system, and the down town streets are exceptionally free from aerial wires. When improvements now planned are completed the Toledo Railways & Light Company will have a circuit capable of carrying 13,000 volts. It has between five and six miles of mains and seventy-two miles of cables. It has the sixth largest underground conduit system in the United States, and is one of the few cities fully equipped with magnetite street lamps.

Electric Car Dealers in New York Form New Association.

The New York city dealers in electric automobiles, accessories, and representatives of central station companies, have formed the Electric Automobile Dealers' Association. Organization was completed at a meeting held on March 25 at the sales rooms of the Rauch & Lang Electric Carriage Company in New York. This local organization is not connected with the Electrical Vehicle Association of America, although the membership of both organizations in similar in many respects. The constitution states: "The object of this association shall be to promote the adoption and use of electric vehicles in Greater New York." The following officers were elected:

President, Alfred Weatherby, of the Anderson Carriage Company, Detroit.

Vice-president, Harvey Robinson, of the New York Edison Company.

Secretary, C. Y. Kenworthy, of the Rauch & Lang Electric Carriage Company.

Directors: R. R. Clayton, of the Studebaker Automobile Company; N. Platt, of the Baker Electric Vehicle Company; W. S. Brown, of the Bailey Electric Carriage Company; A. W. Blanchard, Jr., of the Waverley Company, and C. E. Humphrey, of the Woods Motor Vehicle Company.

Those in attendance at the first meeting were: N. Platt, of the Baker Electric Vehicle Company; Alfred Weatherby, of the Anderson Carriage Company; Hugo Tollner, Brooklyn; A. H. Ackerman of the United States Light and Heating Company; Mr. Higgins, of the Anderson Carriage Company; Harvey Robinson, of the New York Edison Company; Mr. Hawley, of the United Electric Light & Power Company; G. L. Chandler of the Willard Storage Battery Company; W. A. Kundson of the Electric Storage Battery Company; W. G. Brown, of S. R. Bailey & Company; W. G. Bee, of the Edison Storage Battery Company; W. S. Leggett, of the General Electric Company; E. W. Benham, of B. F. Goodrich Company; H. L. Davisson, of the Edison Storage Battery Company; C. E. Watrous of the Cutler-Hammer Manufacturing Company; John H. Barker, of Diehl Manufacturing Company; W. L. Thompson, of Philadelphia Storage Battery Company; Alexander C. MacIntosh, of Studebaker Brothers Company of New York; Harry R. Stokes, of New York & Queens Electric Light and Power Company; W. G. Lange, of Goodyear Rubber Tire Company; W. B. Stoughton, of United Electric Light & Power Company; C. A. Gilbert, of United States Tire Company; Chas. M. Kohn, of Rauch & Lang Carriage Company; and C. Y. Kenworthy, of Rauch & Lang Carriage Company.

Speaking of the purposes of the organization, Secretary Kenworthy outlined a course of campaign which, if carried out, will probably make things lively in the field of electric vehicles. The association will wage a campaign of education with automobile buyers, having as its specific aim the proving of the electric as a better and more economical vehicle for a pleasure car than the gasoline-driven car.

"People don't realize the points of superiority in an electric car," he said. "We all boom our own cars on their peculiar features of preference, but in all of them there is much in common that buyers are not made familiar with. For instance, it is not generally known by buyers that today the electric car can work, on a single charging of the batteries, from 70 to 150 miles, that it is cheaper than gasoline (not costing above one-half to one cent a mile for power). Then, again, anyone can drive an electric car after an hour's teaching, woman or child not excepted. The car has no expense when not running, is not liable to freeze up in cold weather, has no cranking and no complicated machinery to adjust, no clutches, or spark plugs, or radiators to care for. It has its own lights, it occupies smaller space in the garage and saves almost fifty per cent in the salary of a chauffeur. Electric cars can ride on cushion tires of solid rubber, which in a gas car would be impracticable, and can get twice the mileage on a set of tires."

Electrical Exports for February.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has completed its monthly summary of the imports and exports of the United States for the month of February, 1911. From this source the following facts relative to the electrical exports are derived.

The figures for February show a falling off, both as to electrical appliances and electrical machinery, compared with the preceding month. This doubtless is largely due to the shortness of the month and in all likelihood does not represent any prolonged setback. As compared with the corresponding period of a year ago the totals for February show a gratifying gain of over fifty per cent, both as to appliances and machinery exports, thus indicating the strong trend of the electrical exports at the present time.

Comparative monthly data as to electrical exports are given below:

Month.	Electrical Appliances.	Electrical Machinery.	Total.
February, 1911	$939,714	$551,885	$1,491,599
February, 1910	607,359	331,136	938,495
January, 1911	965,936	687,536	1,653,472

A list of the principal countries to which electrical products were sent last February, together with the value of these shipments, is as follows:

Exported to—	Electrical Appliances.	Electrical Machinery.
United Kingdom	$ 32,170	$ 49,331
Canada	268,238	130,002
Mexico	85,551	67,437
Cuba	42,274	30,180
Brazil	187,730	2,873
Rest of South America	101,030	33,838
Japan	71,316	109,048

Kites for Wireless Antenna.

It is reported from San Francisco that by supporting antenna from kites at a height of 1,500 feet, signals could be received from sending stations in Japan and on the Atlantic Coast. Japan is nearly 5,000 miles distant.

TRANSPORTATION FACILITIES OF THE ILLINOIS TUNNEL.

ADDRESS BEFORE THE CHICAGO ELECTRIC CLUB.

Some interesting statistics relative to the operation, transportation facilities and engineering features of the Illinois tunnel system, which underlies the greater portion of the down-town business district of Chicago, were presented by W. E. Worth, superintendent of the company, in an address before the Chicago Electric Club on March 22.

The Illinois Tunnel Company's system comprises approximately sixty-two miles of track, which is all located in what is commonly termed the loop district of Chicago. Tracks are laid under practically every principal street in this district and the company has stations at many of the important buildings in the city.

One of the most important functions of the tunnel service is the removal of excavations from buildings under construction. The speaker cited several instances in which all excavations for new caissons had been made under an old building before it had been torn down preparatory to rebuilding.

All excavated matter is transported to the company's disposal station alongside the Chicago River, where by means of electrically operated conveyors the earth is removed from the cars, raised to the water level and dumped into scows to be shipped and dumped into Lake Michigan.

Transportation of coal is another important feature of the company's service. The tunnel system is connected with a large number of power plants in its district to which it supplies coal and removes cinders. The cinders are disposed of in the same way as excavated material.

The transportation facilities as regards general freight were explained as being exceptionally good, the system being connected with every railroad entering Chicago, save one. There are four public receiving stations where freight is accepted for transportation to the railroad stations.

The tunnels are about forty-five feet below the street level. The dimensions of the bore are 6 feet wide by 7 feet 6 inches high. The cars, which are made up into trains of ten cars, are 13 feet long by 4 feet wide. The motor cars now used for regular service are equipped with two twenty-five-horsepower motors. All current is purchased from the Commonwealth Edison Company and is supplied at 250 volts, direct current. The trolley system of operation is employed.

In reply to a question as to the ventilation Mr. Worth said that the system was equipped with eighty or ninety open-air shafts which furnish the requisite draft. The average temperature in the tunnels the year round is fifty-five degrees. Regarding switching Mr. Worth described the system employed, which is a combination automatic-electric method, invented by a member of the company.

Following the address brief remarks were made by W. N. Matthews, H. M. Wilson and V. Crawford.

Changes in New York Electrical Rules.

The Department of Water Supply, Gas and Electricity of the city of New York announces the following modifications of rules heretofore promulgated, to become effective April 1, 1911:

Rule 12-h, relating to wires on pole lines.—In the fifth paragraph substitute for

The former must be inclosed in a grounded metallic covering and be suitably protected against mechanical injury,

the following:

The former must either be inclosed in a grounded metallic covering or be provided with special insulation approved for this location.

Rule 12-h, sixth paragraph.—Change the first sentence to read as follows:

Mast arms and other conducting fixtures or rigging must be grounded unless provided with insulation specially approved for these appliances.

Rule 12-A-f, relating to guy wires. Add at the end of the paragraph the following:

Anchor guys may be authorized under special permission in writing, given in advance.

Rule 12-D-b, relating to wires within structure of sign.—Omit all after the word "covered."

Rule 12-C-a.—Omit the second sentence relating to services carried through party walls.

Rule 15-d, relating to underground services.—Change paragraph to read as follows:

No underground service from a subway to a building, and no service from a private generating plant, shall supply more than one building until the plans in connection with such supply have received the written approval of the Inspection Department having jurisdiction. Where one or more buildings are supplied from another, the conductors are to be carried outside the buildings. Conductors carried under two inches of concrete under a building or buried back of two inches of concrete or brick within a wall are considered as lying outside the building.

Rule 21-d, relating to energy per circuit.—Insert in parenthesis after the words "660 watts" the following:

or twelve sockets or receptacles,

and after the words "1,320 watts,"

or twenty-four sockets or receptacles.

Rule 22-b, relating to position of knife switches.—Add the following clause at the end of the paragraph:

Or if the throw be vertical a locking device must be provided at the hinge, so constructed as to insure the blades remaining in the open position when so set.

Rule 24-c, relating to fished work.—Add the following sentence at the end of the paragraph:

Attix wire or wire incased in continuous non-metallic flexible tubing must be used for fished work, which will be authorized only under special permission in writing, given in advance.

Rule 24-l, relating to energy on molding circuits.—Change the words "660 watts" to read "1,320 watts (or 24 sockets or receptacles)."

Rule 24-n, relating to covering of wire for conduit work.—Add the following clause at the end of the paragraph:

and must be provided with a lead covering at least one thirty-second of an inch in thickness if the conduit is installed in a damp place and is not water-tight.

Rule 24-A-c, relating to armored cables.—Add the following as a third paragraph:

Ground wires must be run in a neat and workmanlike manner. If the piping system used for a ground is metered, an approved jumper must be carried around the meter.

Rule 25-f, relating to interior conduits.—Add the same paragraph as to Rule 24-A-c.

Rule 25-A-d, relating to metal moldings.—Add as a third paragraph the same rule.

Rule 28-e, relating to flexible cord.—Add the following sentence at the end of the paragraph:

Departure from this rule, in the case of chain fixtures, may be authorized only under special permission in writing, given in advance.

Rule 33-c, relating to emergency switch for car houses.—Omit the words "100 feet of" in the seventh line, and omit the note.

Rule 36, relating to transformers.—Add the following paragraph, to be known as "d":

Transformers for special purposes, where neither primary nor secondary voltage exceeds 550, if air cooled, may be permitted in buildings when so mounted that the case is kept at a distance of at least one foot from combustible material or separated therefrom by non-combustible, non-absorptive insulating material, such as slate, marble or soap-stone. This will require a slab or panel somewhat larger than the transformer.

Rule 49-A-e, relating to outlet boxes.

—Add the following at the end of the second paragraph:

Fixture studs, where not a part of the box, must be made of malleable iron.

Rule 53-c, relating to enclosed fuses.—Add to the italicized note the following paragraph:

Owing to the difficulty of making proper inspection of the fusing where fuses of the cartridge type are used, it is strongly recommended that this type be not employed where plug or link fuses may be installed.

Rule 53-A-a, relating to tablet and panel boards.—After the word "board" in second line of third paragraph, insert the following:

Or where the board will be subject to moisture.

Rule 64-A, relating to wireless telegraph apparatus.—Add the following paragraph, to be known as "e":

Service for equipments of this class must not be supplied except through a one-to-one transformer or converter which has successfully withstood a breakdown test of alternating current at 10,000 volts between coils and between each coil and iron.

Rule 65-A-b, relating to rheostats for moving-picture machines.—Add the following sentence at the end of the paragraph:

Reactance coils, motor generators and similar substitutes for resistance coils must be considered as part of the moving-picture machines, and their location must receive the approval of this Department before installation.

Add a new paragraph to be known as 65-A-j:

The leads to the moving-picture machine and its rheostat or equivalent device must be protected by a plug cutout or by a knife-blade switch with open-link fuses, both inclosed in an approved cabinet with self-closing door. Cartridge fuses will not be permitted.

Rule 66, relating to insulation resistance.—Change the paragraph preceding the table to read as follows:

The wiring in any building must comply with the following requirements:

The complete installation must have a resistance between conductors, and between all conductors and the ground (not including attachments, sockets, receptacles, etc.) not less than that given in the following table.

Rule 67, relating to soldering fluid.—Omit this rule.

A Ten Thousand-Volt Storage Battery.

A storage battery of 4,800 cells and a pressure of 10,400 volts on open circuit, was the subject of a paper recently read before the Röntgen Society of England.

The cells described were contained in five cabinets which held 960 cells each, arranged in twenty-four blocks of forty cells each. Each cell consisted of a glass test tube four inches long and having a one-fourth-inch bore, and each set of forty cells was cast solid with paraffin wax into a wooden tray. The battery was of the Planté type, and the plates, which were not pasted, were made of sheet lead cut off into strips in a machine similar to that used for trimming photographs. Each strip was further bent round a shaped piece of wood and pressed in a hand press, with the result that the lead was given a corrugated form which was not so liable to deformation. These plates were put into the test tubes, with dilute sulphuric acid, and kept from touching each other by means of celluloid separators. All the plates were originally treated in a forming battery before being transferred to the battery proper.

To avoid bubbling of the acid it was found best to charge the battery at a rate not exceeding ten milliamperes, and it was capable of discharging at a rate of 150 milliamperes or over for several minutes, which meant a discharge of one and one-half kilowatts. The internal resistance varied with the current between 3,000 and 4,000 ohms.

With the full 10,000 volts between polished brass balls 12.5 millimeters in diameter, the current was found to jump some 2.5 millimeters, and the resulting arc could be drawn out to a considerable length largely dependent on the amount of resistance in the circuit and the consequent strength of current. That the current was often not entirely continuous was evidenced by the fact that the arc made a whistling sound of very high periodicity. By connecting a Leyden jar across the arc the latter was immediately converted into a series of discontinuous sparks, which, if the jar was of small capacity, followed one another very rapidly, making a musical note.

The frequency was increased by shortening the spark-gap, and decreased by adding resistance to the circuit. When eleven half-gallon jars were coupled in parallel, and some yards of wet string inserted into the circuit to obtain high resistance, the discharges took place at surprisingly regular intervals, ranging from one second up to seven seconds. A Geissler tube, put between the battery and the jars, lighted up brilliantly with the rush of current at each discharge, the brightness diminishing as the current decreased.

Mr. Swinton then imitated the electro-capillary effect—so far unexplained, he stated—discovered by Lord Armstrong and later repeated with an induction coil. A glass vessel containing pure water was divided into two parts by an inner glass cell. This cell was provided with an orifice, through which a thread of cotton was passed. When the current of 8,000 or 10,000 volts and 5 milliamperes was turned on, the cotton thread moved in the direction of the negative current, rising visibly like a snake, while the water moved in the opposite direction. This was what Armstrong had observed. On addition of sulphuric acid to the water, electrolysis started, and the movement of the thread was much slower (Armstrong had not been able to observe it at all in this case), but the flow of the water was increased.

Mr. Swinton then described the mechanical effects on mill-wheels of mica or aluminum, which, as he had demonstrated in 1907, were rotated by Goldstein's canal rays with the intermittent discharges of an induction coil. This rotation took place when an intermittent spark passed between anode and cathode, no matter whether the tube was exhausted or not, or what the current direction. It would, therefore, appear that the rotation was merely due to the air circulation, produced by th explosive sparks, and was not dependent on cathode or canal rays. With the continuous battery current, rotation did not set in until the exhaustion of the tube had been carried to the degree suitable for canal rays; the canal rays then observed did not differ in appearance from ordinary canal rays, and the mill-wheels, placed behind the cathode, rotated in the direction of the canal rays as in induction-coil experiments. With the mill-wheel in front of the cathode, the mica vanes turned in the direction of the cathode rays (away from the cathode), but the aluminum vanes turned in the opposite direction to the canal rays. The exhaustion had so far been moderate.

At very high exhaustion the phenomenon changed. The mill-wheel was then entirely contained in the dark space; a mica wheel was seen also to rotate in the direction of the canal rays, but to reverse when the vacuum fell off. The aluminum wheel became, at the highest exhaustion, so highly electrified (positively) that it was lifted off its point by the electrostatic attraction of the cathode; hence a rotation could not be observed.

LETTERS TO THE EDITOR.

Telegraph Repeaters.

To the Editor:

In the last paragraph of the article on "Telegraph Repeaters" in your issue of March 18, the writer observes that an error crept in in the fourth line, which reads "the wire A^3 A^5 and the ground G." This should have read "the wire A^3 and the ground G."

Rochester, N. Y. H. P. CLAUSEN.

The Stretching of a Conductor by Its Current.

To the Editor:

In a recent article by Carl Hering on "The Stretching of a Conductor by its Current," published in the *Journal of the Franklin Institute* and abstracted in your paper, the author, in his introductory remarks, states that the textbooks "do not teach anything about the forces in the conductor itself produced by its own current." However, the fundamental relations pertaining to the problem in question are clearly stated in the "usual treatises and textbooks." If we take the equation for the electromotive forces in an inductive circuit

$$e = r\,i + \frac{\delta\,(Li)}{\delta t} \qquad (1)$$

and multiply by the current we have the power equation

$$ei = ri^2 + iL\,\frac{\delta i}{\delta t} + i^2\,\frac{\delta L}{\delta t} \qquad (2)$$

Here

$e\,i$ represents the power supplied to the system,

$r\,i^2$ the power dissipated in the conductor as heat,

$i\,L\,(\delta i/\delta t)$ the power stored (rate of increase of magnetic energy).

and $i^2\,(\delta L/\delta t)$ the power converted (electrical power to mechanical power).

But the power converted is the mechanical force, F, times the speed $\delta s/\delta t$, where s represents distance. Therefore

$$F = i^2\,\frac{\delta L}{\delta s} \qquad (3)$$

That is, wherever a small displacement of any part of a conductor results in an increase of the self induction of the circuit there is a mechanical force, proportional to the square of the current, tending to cause such a displacement. Equation (3) gives the mechanical force on any element of the conductor due to the current, in terms of the total current and the rate of increase of the total self inductance with respect to a displacement of the element in question. The force, of course, is in the direction for which $\delta L/\delta s$ is a maximum. The element considered may be of any size whatever from infinitely small up to and including the full cross section and any fraction of the total length.

From this it follows that under some conditions a current through a conductor causes forces such as to require a tension in the conductor to maintain equilibrium, that is the forces tend to increase the length of the conductor. It also follows that under other conditions the forces are such as to tend to decrease the length of the conductor. Further, under most conditions the force on an element of the conductor near the surface is such as to tend to crowd it toward the center.

For example, a conductor in the form of a circle of radius A and of circular cross-section of radius a has a self inductance

$$L = 4\,\pi\,A\left[log\,\frac{8A}{a} - 1.75\right] \qquad (4)$$

This is the approximate formula of Kirchhoff which when differentiated gives

$$\frac{\delta L}{\delta a} = -\,4\,\pi\,\frac{A}{a} \qquad (5)$$

$$\frac{\delta L}{\delta A} = 4\,\pi\left[log\,\frac{8A}{a} - 0.75\right] \qquad (6)$$

Multiplying (5) by i^2 gives the total force acting on the conductor radial to its axis. This divided by the surface, $4\,\pi^2\,A\,a$, gives the force per unit area

$$f = -\,\frac{i^2}{\pi a^2} \qquad (7)$$

Here the minus sign signifies that the force (which is not an external pressure) is towards the axis.

Multiplying (6) by i^2 gives the total force radial to the center of the circle, which when divided by 2π gives the tension

$$T = i^2\left[2\,log\,\frac{8A}{a} - 1.5\right] \qquad (8)$$

Neglecting the effect of the hysteresis, equation (3) also gives the force, due to the current, between a conductor and a piece of soft iron placed in its neighborhood, or if there are several pieces of soft iron, the force between any one and the rest of the system. For example, the force on one of the prongs of an electrically driven tuning fork is

$$-\,4\,\pi\,i\,\frac{n^2}{R^2}\,\frac{\delta R}{\delta s}$$

where R is the reluctance of the magnetic circuit and n is the number of turns in the winding.

If the system is of such a form that the rate of change of the self induction with respect to displacements of the elements can be calculated it is seen "that when a conductor is removed from all other conductors or magnets" the fundamental relation between electromotive force, current, resistance, self inductance and time; combined with a fundamental conception of mechanics enables one to determine the "pinch effect," the tension or any other effect which is the result of mechanical forces on the elements of the conductor, due to the current.

Of course, it is possible that a current in a conductor causes a mechanical force other than the electri-magnetic and electrostatic forces, the former only having been considered above. So far, however, no one has shown the presence of any such additional force.

Washington, D. C. F. WENNER.

Engineering in War.

At a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers, held in the Society's rooms in the Monadnock Block, Chicago, Caryl D. Haskins, of the General Electric Company, presented a paper entitled "Engineering in War."

Mr. Haskins showed how the methods of warfare had undergone gradual evolution, so that instead of brute force there is more and more employment of engineering tact and skill. War will come to an end when the engineering profession will make it so deadly, speedy and decisive that it will be out of the question as a means of settling international disputes. Meanwhile the science and art of war is a highly specialized work in which practically all branches of engineering are called on to take an active part. The present engineer corps in this country is too small. Mr. Haskins, therefore, made a strong plea for the organization of a volunteer corps among the leading engineers of the country to act as an advisory body in times of peace and as a very important auxiliary in emergency.

Among those who discussed Mr. Haskins's paper were Chairman G. T. Seely, Profs. W. F. M. Goss and Morgan Brooks, Colonel Green and Messrs. Abbott, Woodmansee, Postel, Schuchardt and Pomeroy.

CENTRAL·STATION·PRACTICE

Transmission~Interior Wiring

EUROPEAN SWITCHBOARDS OF STEEL, IRON AND CONCRETE—II.

BY STEPHEN Q. HAYES.

One of the most important plants installed by the Maschinen Fabrik Alioth is the Brusio Power Plant, comprising a hydraulic generating station at Campocologno, on the Swiss side of the Italian boundary line and a step-up transforming station at Piattamala in Italy. These stations are connected together by means of a tunnel approximately 1,600 feet long containing two 7,000-volt feeders, each of approximately 18,000 kilovolt-ampere capacity. These two stations together are known as the Brusio Plant.

The generating station contains twelve hydroelectric turbine units, each of 3,000 kilovolt-ampere capacity and four exciter turbine sets.

In the Piattamala transforming station, there are twenty-four 1,250-kilovolt-ampere oil-insulated water-cooled single-phase transformers of Alioth make. These transformers are connected in groups of three for stepping up the voltage from approximately 7,000 volts to approximately 50,000 volts. These transformers are star-connected for both high tension and low tension, and the neutral points of both high-tension and low-tension stars are grounded through horn gaps.

Fig. 16 shows the transformer control panel and the general arrangement of the transformer switching devices, in the Piattamala station, where there are twenty-four 1,250-kilovolt-ampere transformers, 7,000 volts—50,000 volts. Each group of transformers is provided with a cabinet panel of the type indicated, containing three ammeters, operated from series transformers in the low-tension circuit, two single-phase relays and one operating handle that closes the three single-pole oil switches in the high-tension circuit, and the one three-pole switch in the low-tension circuit. These switches are operated from a single shaft which passes through the various compartments and is actuated by the long double arm shown near the bottom of the transformer panels.

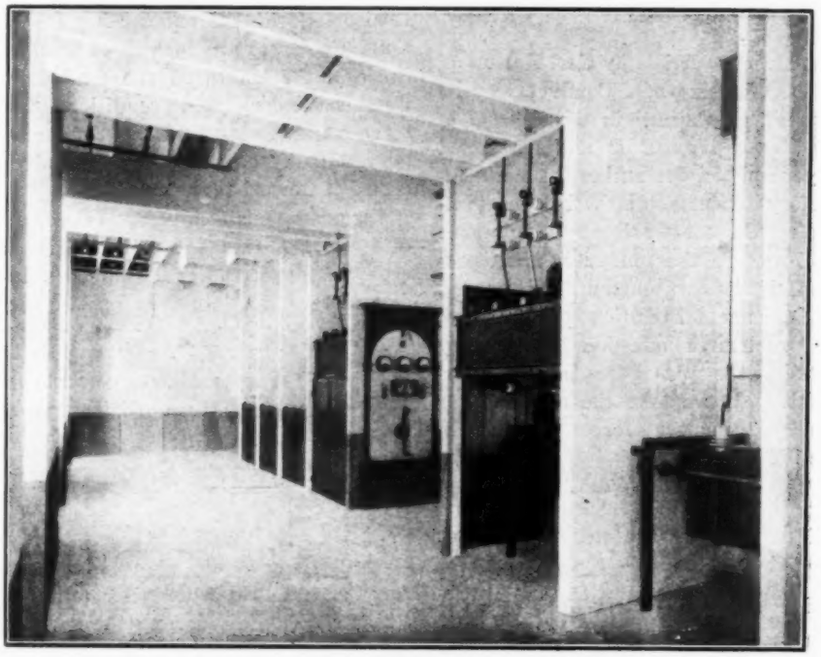


FIG. 16.—ALIOTH TRANSFORMER PANELS, PIATTAMALA.

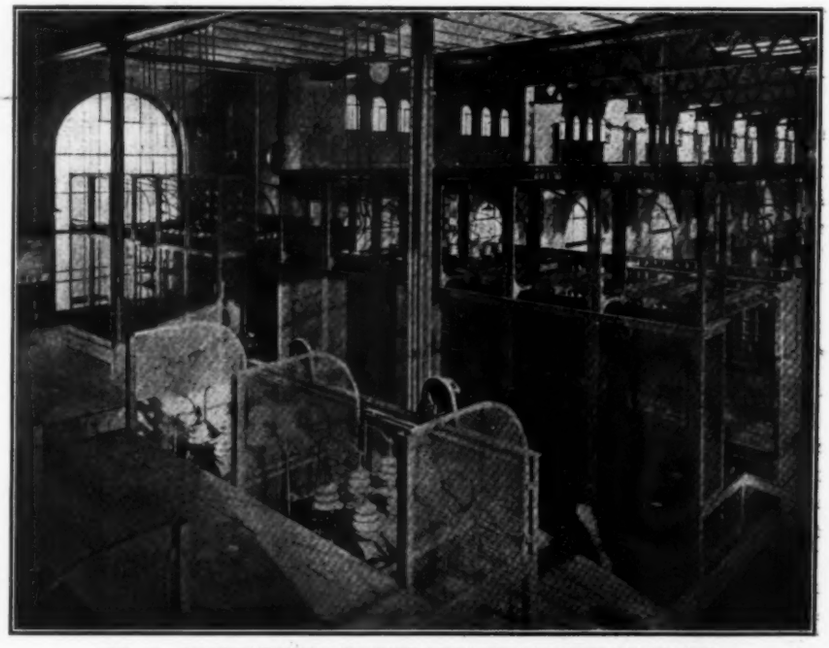


FIG. 17.—BROWN-BOVERI CIRCUIT-BREAKERS IN BEZNAU PLANT.

The overload relays, operated from series transformers in the low-tension circuit, trip out both the low-tension and high-tension oil switches. This scheme of operating the high-tension and low-tension transformer switches together has a good many points in its favor, but is not generally used in American practice.

This Brusio plant is provided with a stepdown transformer station and steam reserve plant at Castellanza with engine-driven generators of 2,500 horse-power and turbo-generators of 5,000 and 7,500 horsepower.

Fig. 19 shows the way in which the Alioth Company combines the breakers on the low-tension and high-tension sides of a transformer bank in the Castellanza Station. The three-pole breaker on the right controls the low-tension end of the bank of transformers, while the single-pole breaker with three double breaks per pole on the left, with two other single-pole breakers that do not appear in the illustration, controls the high-tension circuit. All of these breakers are worked by one common shaft that is operated by a long double-arm handle placed on the transformer panel. This cut also shows the oil-immersed series transformers in the high-tension and low-tension circuits, as well as the double-spiral choke coils and disconnecting switch in the 44,000-volt circuit.

A good example of grill-work inclosure for low and high-tension breakers is that installed by the Brown-Boveri Company at Beznau on the Aare River in the northern part of Switzerland. This station contains eleven vertical-shaft water turbines running at sixty-six and two-thirds revolutions per minute direct-connected to 900-kilowatt, 8,000-volt, fifty-cycle, ninety-pole, three-phase generators; two vertical-shaft turbines for the exciters; two 2,400 kilowatt, 8,000-volt, fifty-cycle, ninety-pole, three-phase generators; two vertical-shaft turbines for the exciters; two 2,400-kilowatt, 8,000-volt, , fifty-cycle, four

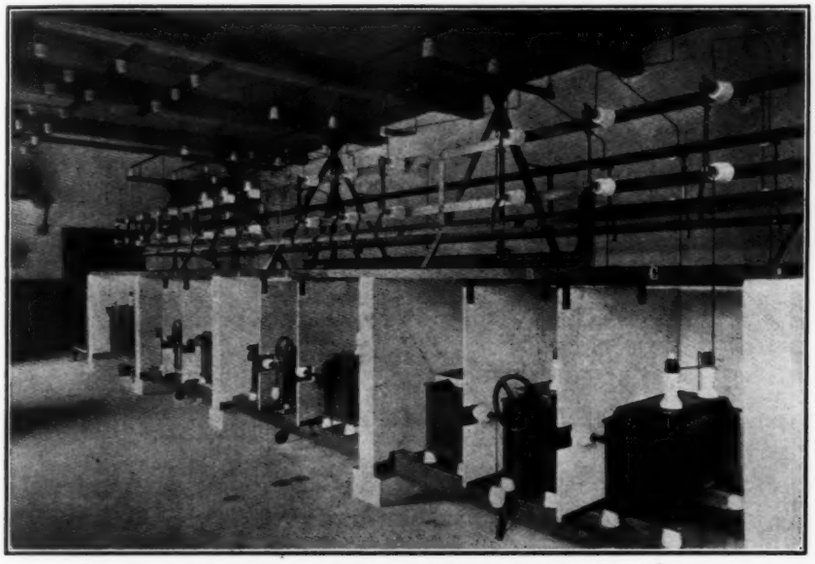


FIG. 18.—SIEMENS-SCHUCKERT CIRCUIT-BREAKERS AT LEIZERAN.

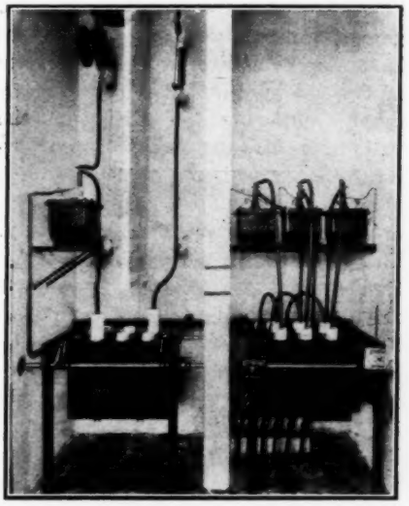


FIG. 19.—ALIOTH CIRCUIT-BREAKERS FOR 44,000 VOLTS AT CASTELLANZA.

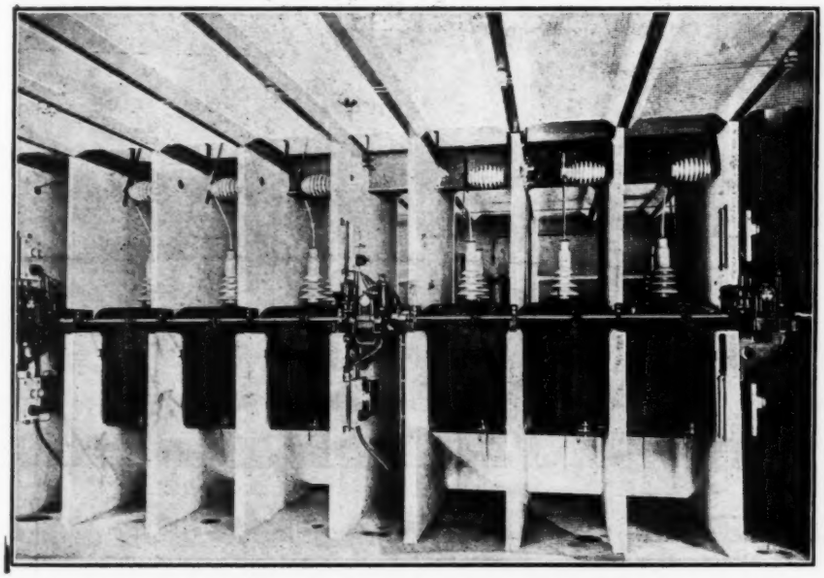


FIG. 20.—BROWN-BOVERI CIRCUIT-BREAKERS IN PIEDIMULERA STATION.

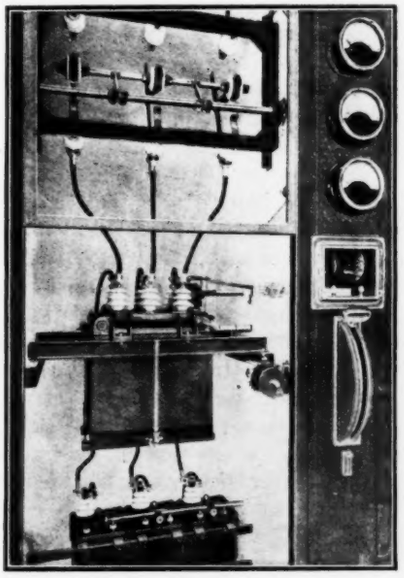


FIG. 21.—BROWN-BOVERI CIRCUIT-BREAKERS IN MASSAGNO PLANT.

pole, three-phase turbo-generators, 1,500 revolutions per minute with direct-connected exciters; seven three-phase oil-insulated, water-cooled transformers, each of 2,000 kilovolt-ampere capacity, stepping up from 8,000 to 27,000 volts, with some smaller transformers stepping down to 250 volts for station service. 8,000-volt feeder circuits are run to Wehr, Dottingen, Baden, Beznau and Unbenufzt, while 27,000 volt feeders are run to Rhinefelden, Ober-Seebach, Lentzburg and Unter-Seebach. The general scheme of connections is to have the generators connect to either of two sets of three-phase busbars arranged in the form of a ring and the various feeder and low-tension transformer circuits also to connect to these busses, which are so sectionalized as to secure a great amount of flexibility. The high-tension side of the step-up transformers also connects to two sets of ring busbars that supply current to the 27,000-volt feeders.

Fig. 17 shows the general appearance of the switchgear compartment looking towards the generating station. The oil breakers in the lower left-hand part of the picture are those in the 27,000-volt circuits from the transformers. The grill-work partitions between the leads and the round-pattern ammeters mounted on the steel framework are great departures from American practice. The structure for the 8,000-volt feeder circuits can be noticed in front of the transformer switch structure.

A typical example of the combination of concrete and steel for circuit-breaker compartments and switchboard construction, as employed by the Brown-Boveri Company, is shown in Fig. 21, one of the compartments for the 3,600 volt transformer switchgear in the Massagno substation of the Verzasca system, where the 24,000-volt lines from the Gordola generating station have their voltage stepped down to 3,600 volts. A three-pole mechanically operated knife switch in the upper left-hand portion of the picture isolates the oil switch and other apparatus from the overhead busbars. The three blades of this are attached to insulators mounted on a shaft which is operated by chain drive from a shaft in the compartment to the left, which shaft in turn is driven by the bevel-gear apparatus to the right of the oil circuit-breaker. The shaft of the bevel-gear device has a square end that projects through the sheet-metal door that ordinarily incloses all of the switchgear, and before the door can be opened this shaft must be turned by a socket wrench in such a manner as to operate the disconnecting switch and isolate the apparatus from the bus. This is typical of the precautions taken to safeguard the attendants in European plants.

The oil circuit-breaker is operated by a rotary motion obtained from a shaft projecting through the right-hand wall and driven by a chain actuated by the handle projecting through the large sector to the right. The smaller handle below actuates the tripping device of the breaker. A device is provided for lowering the oil tank to obtain access to the contacts, and an oil gauge in the front shows the height and condition of the oil.

Series transformers of the oil-immersed type are located at the bottom of the compartment and supply current to the ammeters and overload relay on the adjacent section.

The various transformer and feeder compartments for the 3,600-volt circuits form a practically continuous switchboard on the floor above the transformers and below the busbars.

As an example of the concrete construction used by the Brown-Boveri Company for high voltage, Fig. 20 shows two of the 45,000-volt three-pole automatic oil circuit-breakers used in the Piedimulera generating

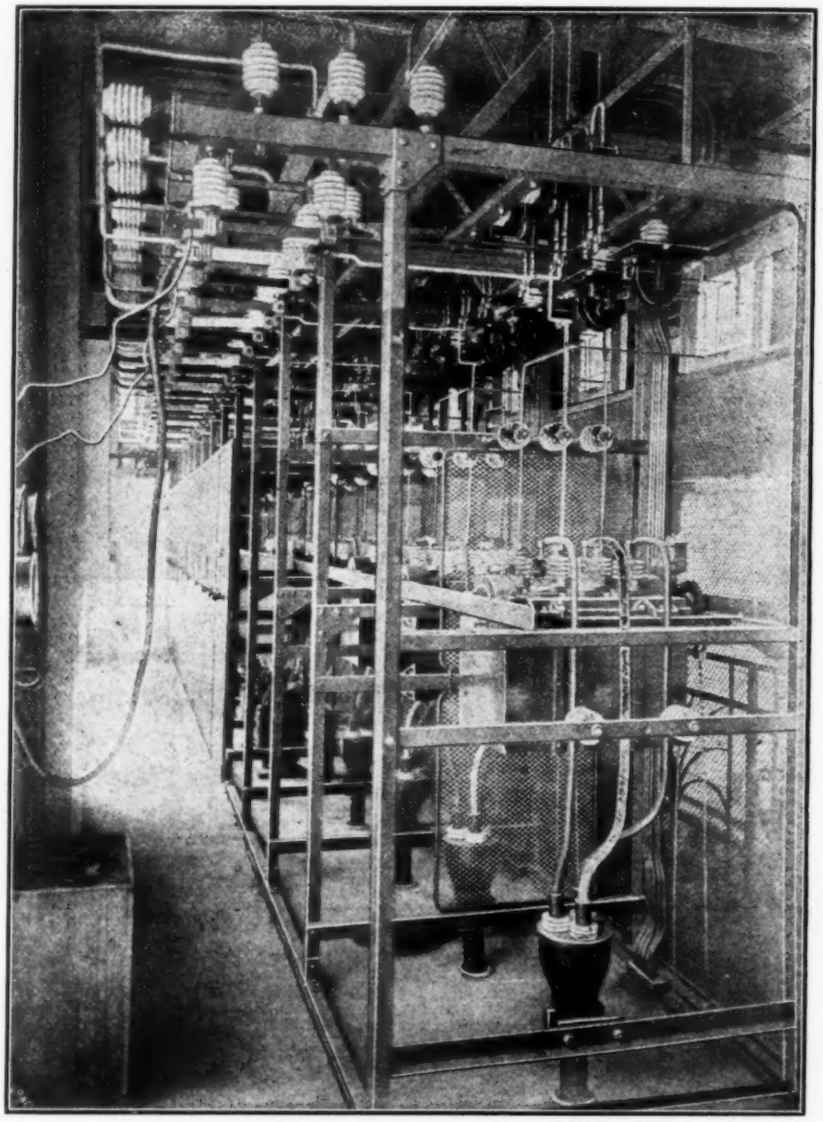


FIG. 22.—LAHMEYER SWITCHGEAR, WANGEN STATION.

station of the Dell'Anza system mentioned before. Each breaker has its three poles in independent masonry compartments and is provided with six breaks in series per pole. The three poles are actuated by a common shaft driven by a motor with suitable clutch couplings and a spiral spring device. The concrete walls between the poles of the breaker are excellent examples of this kind of work. The porcelain bushings in the top of the

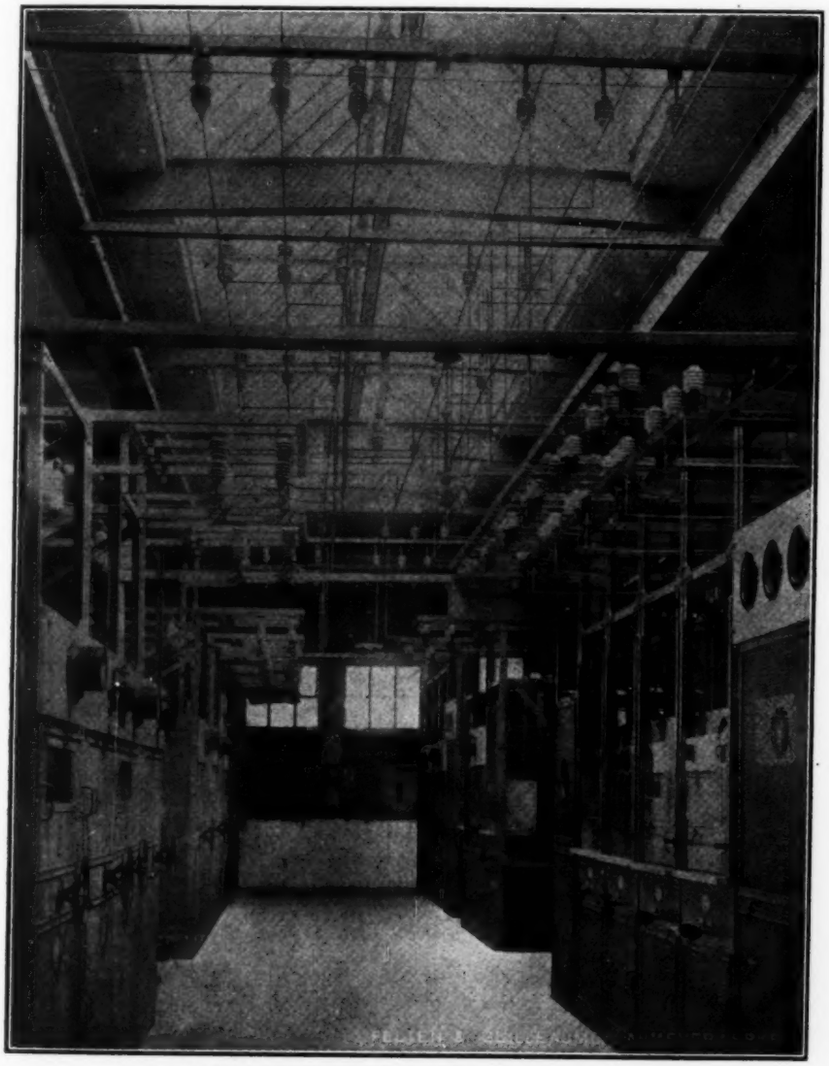


FIG. 23.—LAHMEYER SWITCHGEAR, LUTERBACH STATION.

circuit-breaker tank and the porcelain studs of the swinging-type disconnecting switches are typical of European practice. As may be noticed, one set of leads passes downward back of the oil tanks through the floor to the terminals of the 2,300-kilovolt-ampere transformers, while the front leads pass upward to the swinging-type disconnecting switch and thence through the ceiling to the busbars on next floor.

One of the important plants installed by the Felten - Guilleaume - Lahmeyerwerke is that of Wangen on the Aare River in Switzerland, where there are six 1,250-kilowatt, 11,000-volt, fifty-cycle, three-phase generators with provision for a seventh unit, supplying power over four feeder circuits to a transforming station at Luterbach, where the system ties in with the 25,000-volt lines to Dalemont and Basel. From Luterbach 10,000-volt feeders are run to Solothum and other places, and 2,000-volt feeders are run on the two-phase, three-wire system to various substations.

In the generating station the connections are very simple, as all of the generators operate in parallel on a single set of busbars supplying current to the four feeder circuits. In this station a panel-type of switchboard is provided on the generator floor while the mechanically operated distant-control oil breakers with the busbars and all high-tension apparatus is located on an overhead gallery, and is arranged in the manner shown in Fig. 22. As may be noted, a framework of structural iron is provided for the support of the oil circuit-breakers, busbars, disconnecting switches, etc.

The three-phase busbars are supported on the vertical corrugated pin-type insulators attached to the top cross brace and the leads pass over insulators at the left-hand end of these braces to the disconnecting switches mounted below them, to the series transformers, thence to the breakers and the three-conductor cables for the generator and feeder circuits.

In the various substations the switchgear is placed in inclosures of structural-iron and expanded-metal construction, as shown in Fig. 23, a view of the transformer switchroom in the Luterbach Station. This station controls the four incoming 10,000-volt lines, three outgoing 10,000-volt lines, two three-phase to two-phase transformer units supplying four 2,000-volt two-phase three-wire feeders, two 250-kilowatt, two 500-kilowatt and two 1,000-kilowatt three-phase transformers stepping up to 25,000 volts for two feeder circuits to Dalemont and Basel.

The handwheels for operating the oil circuit-breakers can be seen projecting through the iron plates of the structure while the instruments are mounted on panels higher up on the framework. The overhead open busbars, disconnecting switches, bare wiring and insulators present a very workmanlike arrangement secured at a moderate cost.

The Siemens-Schuckert Company, has equipped three generating stations of 4,000, 4,000 and 8,000 horsepower for the Sociedad Hidro Electrica Iberica in the north of Spain, and Fig. 18 shows the arrangement of the 33,000-volt circuit-breakers, disconnecting switches and busbars in the Leizeran Station where there are four 865-kilovolt-ampere, fifty-cycle three-phase 3,300-volt generators feeding into a ring bus that in turn supplies four step-up transformers supplying a 33,000-volt bus used for two outgoing

feeders. Each pole of the breaker is in a separate compartment with concrete barriers between the poles, which are operated together by a rope-driven mechanism acting through a crank shaft and insulated couplings. The 33,000-volt busbars are all in plain sight and can readily be inspected in a minimum amount of time.

While it was felt impossible to go far into detail on this subject of European switchboards in a short article or to do full justice even to the particular points that are covered, it is hoped that the illustrations and descriptions may be of interest and value to American engineers as giving them some idea of the lines along which their European friends are working.

Fungus Growth in Rubber Insulation.

The attention of electricians in Germany has been called to the destruction of rubber insulation by fungus growths, even when inclosed in conduit of enamelled iron. Any iron rust promotes the growth of the fungus which accelerates the breakdown of the insulation. Of course, the formation of rust and the growth of the fungus are impossible except in the presence of moisture. Therefore, the remedy is to see that all iron is quite bright when put in the tube, and to insure the dryness of the tube interior by blowing hot air through it. The future access of damp must be prevented. Disinfecting the tube with a strong solution of carbolic acid has been suggested, but there are several drawbacks to this procedure. The phenol will probably escape before the water with which it is mixed has disappeared, and the resistance of india-rubber to the prolonged action of the acid is at least doubtful. If circumstances make it impossible to keep the inside of the tube dry a first-class red-lead paint is the best preservative against both damp and fungi.

Examination for Junior Engineer.

The United States Civil Service Commission, Washington, D. C., announces that on April 12 and 13 an examination will be held at the regular places to secure eligibles for the position of junior (mechanical) engineer for the Bureau of Mines at Pittsburg, Pa., or for other similar positions. Those interested should apply to the Civil Service Commission for examination form No. 1312.

THE RELATION OF MANAGER TO EMPLOYEE.

BY L. MURRAY OLMSTED.

The attitude of the manager of an electric lighting company toward those under him has much to do with the amount of cheerful service rendered him and no little part in his own success.

The old saying that familiarity breeds contempt, is true, but there is a fine point in distinguishing between familiarity and creating of good fellowship.

The manager has a right to feel that he is better than his help. He is, else he would not be holding the position he does. Though at all times living up to the dignity of his position, he must not overstep the importance of it, or he will antagonize rather than win the respect of those under him. He is called upon to deal with men of many different classes and dispositions; his alertness in reading human nature will aid or in fact determine his success in handling them. It cannot be expected that the manager is an expert bookkeeper, stenographer, solicitor, electrician, engineer, janitor, etc., but he can learn enough about each one of them to know what these particular branches ought to do to contribute their share toward the success of the company, make himself competent to ask intelligent questions and direct each line of work.

Employees are very quick to detect ignorance in their superiors and often take advantage of it in very harassing ways, often creating lack of confidence in the other help. Acknowledge faithfulness to duty, by encouragement of words, if not promotion.

Keep in touch with all branches of work by continual consultation, encouraging confidence and the idea that the success of the company is not coming through the capacity of one man, but requires the co-operative team work of many men. Be emphatic in the fact: We are all working for The Electric Light Company. I, the manager, represent the company to you, I represent you to the company. I am accountable for every man's work. I must make good to the company and each and everyone of you must make good to me. It is a successful plan to bring all the working force together at least four times a year for a review of work done, and talk over plans for future work. In doing this each member feels a personal responsibility for making a good showing in his particular line of work. Much of the petty jealousy that is bound to exist is in a measure dispelled and a unanimous desire for the success of the company is created.

It is quite natural that employees as a rule regard themselves as working for the interest of the manager and personal dislikes and grudges are stored up to a detriment, when really the employee means no ill feeling toward the company, so, impressing forcibly the necessity of keeping in mind the idea that all are working for the interest of the electric light company has much to do with crushing out personal antagonism and giving each member of the force a certain responsibility and knowledge that confidence is placed in him and that his best efforts must be put forth and will be recognized as his part of its success.

The successful manager is the one who knows the worth in dollars and cents to the company of each and every man under him. He must know the requirements of every office to be filled and the ability and qualification of the man to fill it.

He must know when to promote and when to discharge. He must know personally to a degree every man and his habits. He must be a reader of human nature, to handle men. He must be shrewd in handling money, for at the end of the year the company expects him to hand them every dollar's worth of his salary with a generous profit.

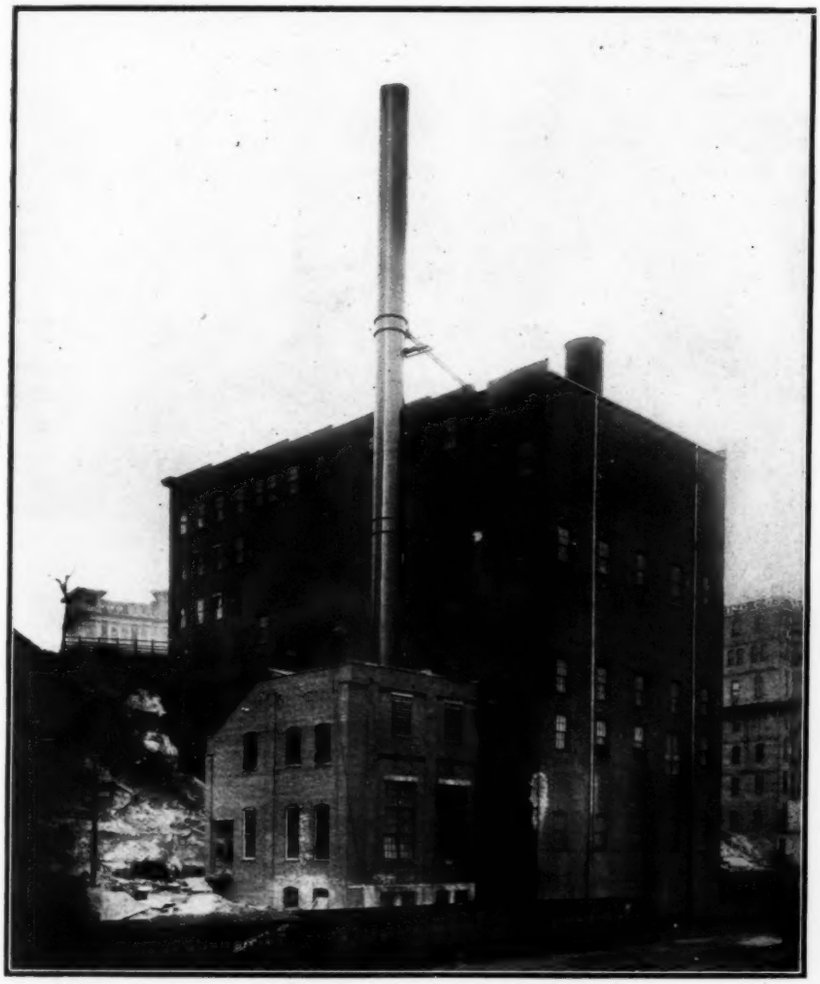
He must have for his motto: All Together, Work.

Best Thickness for Laminations.

In a communication to the *Elektrotechnische Zeitschrift*, E. Jasse deduces the best relation which can exist between the thickness of the steel sheets in laminated cores and the thickness of the insulation separating them. The Steinmetz equation for the total loss is assumed, and it is found that this will be a minimum when the thickness of the sheet bears to the thickness of the insulation the same ratio as eight tenths of the hysteresis loss bears to the eddy-current loss.

A Departure in Stack Construction.

The guying of the steel smoke stack of the recently constructed addition to the main station of the Northern Heating & Electric Company, of St. Paul, Minn., presented a number of peculiar features and the method finally adopted is unique in that it accomplishes its object in a thoroughly satisfactory manner and at the same time is much more economical than any other method possible.



ADDITION TO NORTHERN HEATING & ELECTRIC COMPANY'S STATION SHOWING METHOD OF STACK SUPPORT.

The original station, constructed in 1906, is of brick, steel and concrete construction, six stories high, and is located on the north side of the Mississippi River at Third and Market Streets which is a very convenient location both as regards coal and water supply, as well as being close to the steam and electric load center. The equipment consists of eight Edge Moor boilers of a total capacity of 4,600 horsepower, six of which are equipped with Murphy stokers, economizers and induced draft systems, and two have Green chain grates with natural draft.

The generating equipment consists of one 2,000-kilowatt, two 1,000-kilowatt, and one 300-kilowatt Westinghouse turbo-alternators. During the heating season these turbines are operated non-condensing against a back pressure of about five pounds. When operated condensing these machines would develop about 6,500 kilowatts.

The underground steam mains and electric distribution system are in tunnels and cover practically the entire down-town district. The center of the down-town district is served with direct current from a substation located in the Manhattan Building, at Fifth and Robert Streets, where are are two 400-kilowatt motor-generator sets. Outside of the underground district service is furnished by overhead wires. The midway manufacturing district is served from a substation in St. Anthony Park, to which current is transmitted at 6,600 volts.

Steam heat and electric service are furnished to the principal buildings in the city.

During the past season the steam-heating end of the company's business increased to such an extent that additional steam-generating apparatus had to be added. An addition to the original plant was, therefore, built adjoining it and two 500-horsepower Edge Moor boilers installed. The new smoke stack which was subsequently built is of steel construction, is 130 feet high and 6.5 feet in diameter.

Owing to the design of both the old and new structures, the ordinary method of supporting the stack was impossible. It was, therefore, decided to anchor the stack with steel struts.

At a point forty-five feet from the base of the stack is a steel band to which two steel struts are connected, these in turn being fastened to the steel columns in the wall of the old building. The struts are made up of four angles 3.5 by 2.5 by .25 inches, placed back to back and reinforced with lattice work. Holes were drilled in the old brick wall to allow the struts to be joined to the steel columns, the latter being approximately twenty-five feet apart. The center line of the stack is 19 feet 8.5 inches from the center of the wall of the old plant.

The second supporting band is ninety feet above the base of the stack and 12.5 feet above the top of the old wall. The method of supporting is the same at this point as at the lower guy.

E. Holcomb is the manager of the plant. All engineering work was done by H. M. Byllesby & Company, Chicago, who control the property.

Gas Producer Experiments.

At the Experiment Station of the United States Bureau of Mines, Pittsburg, Pa., several trial runs have been made with an experimental gas producer, using coke as fuel, with which limestone has been mixed in varying proportions, the purpose being to flux the ash and form a liquid slag, thus avoiding clinker and ash troubles and consequent shut-downs. Liquid slag has been readily made which runs freely from the producer. The high temperatures necessary are very efficient in the generation of gas.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ELECTRIC STREET LIGHTING.—I.

BY ALBERT SCHEIBLE.

From the earliest days of electric lighting to the present, street lighting has always been one of its important fields, this being due partly to the superiority of electric lamps over other street illuminants and partly to the revenue derived from this use of the same. Indeed, the history of hundreds, if not thousands, of electric light plants shows that without the assured revenue from street lighting they could not have paid expenses during their earlier years. Our electrical journals have brought forth many scattered articles on one phase or another of this important subject during the last thirty years, during which time both the methods used and the results sought in street lighting have changed considerably. These changes in both aims and methods are still going on, but even those actively interested in this important line often find it difficult to trace the lessons taught by the past or to clearly discern the general trend of present developments. Hence a series of articles briefly tracing the history of street lighting from the earliest recorded times to the present, with a due consideration of the aims as well as the methods used, may prove of value to those directly interested in electric lighting as also to the far greater number who need to have a clearer conception of the tendencies and the possibilities of electric street lighting if they are properly to lend their support to its further progress.

PRE-ELECTRIC STREET LIGHTING.

Traced to its earliest recorded stages, street lighting started with the single function of pathfinding, which in olden times was accomplished by torches or lamps carried by pedestrians. The man who wanted to leave both of his hands free strapped a little lamp to the sandal of one foot, thus lighting the path before him. Probably this was what inspired the familiar lines of one of our famous orators: "There is but one lamp by which my feet are guided and that is the lamp of experience." The lantern which Diogenes incidentally used in his search for an honest man, is historic and according to Plutarch (about 100 A. D.) no citizen of his time would go out at night unless accompanied by a slave carrying either a torch or a lantern.

The first departures from these perambulating lights seem to have been the festal illuminations occasionally held both in Greece and in Egypt in celebration of religious feasts, weddings and the like, thus introducing the element of display which during the last five years has become a function of street lighting in many American cities. For instance, when Cicero returned to his home after exposing Catiline's conspiracy, his way was lighted by lamps and torches set along both sides of the street. These festal displays were of short duration and the first instance of outdoor lamps kept burning regularly (as reported by Tertullian, about 200 A. D.) consisted of lamps hung before each door of the Roman houses in what corresponded to our "red-light" districts. During the later periods of the Roman empire, the entrances to the public baths were also lighted by outdoor lamps. Thus in the oldest recorded instances of continued and municipally ordered outdoor lighting the lamps not only lit the way for pedestrians, but also showed the business nature of the buildings before which they were placed—a trade-drawing function of street lighting which has been too generally overlooked since that time.

For street lighting disconnected from festivals or from any particular class of buildings, we find the earliest instances in Antioch (Syria) in the fourth century, where the more important streets and squares were lit by lamps hung from ropes. Of the gradual spread of this practice through Europe, little has come down in history except as to certain large cities. In Paris, an edict of 1524 ordered lights to be placed in front of the windows, to which pitch pans were added at the street crossings in 1558. In London an act of Parliament in 1662 decreed that every resident should hang a lantern before the door of his house, to burn from dusk till 9 p. m. every night from Michaelmas to Candlemas (September 29 to February 2). In 1736 the lighting was turned over to a corporation and in 1814 gas street lighting, which had been adopted at Pall Mall in 1807, was generally installed in London.

In Berlin an edict of 1680 ordered "a lantern, therein a burning light, to be hung out at each third house, so be it that the lamps are alternately supplied by the neighbors." This plan did not prove satisfactory, so in spite of the protests of citizens against paying for the same, lamps were erected on posts during the same year and an "inspector of city lighting" was appointed to look after the same. A lantern ordinance issued two years later, prescribed the hours during which street lamps were to burn in the cities of Berlin and Cologne, the hours being greatest in December and January, with light from 5 p. m. till 7 a. m., while no light whatever was to be furnished during May, June, July and August. Some years later the lighting was turned over to a private party, but with the assured protection of the ruler, which was needed, as the lanterns were so frequently stolen that even a reward of ten dollars offered to the one reporting the culprit was inadequate. The penalty for street-lantern theft was gradually increased to $200 or expulsion from the country. The lanterns used were three-sided, mounted on wooden poles and each fitted with a little flickering oil lamp. Leipzig also seems to have been early in adopting lamp-posts, as pictured on a souvenir medal issued in 1702 to celebrate the

introduction of street lamps placed on wooden poles.

In this country, Benjamin Franklin's improvements in oil lamps (for which he modestly sought no patents) were promptly utilized for street lighting, though little headway was made until Baltimore, Boston and New York all adopted gas for street lighting during the years 1820 to 1823.

This introduction of street lights into one city after another was not without opposition, the most notable being that at Cologne, where the influential *Koelnische Zeitung* bitterly contested the proposed gas street lamps for seven remarkable reasons:

(1) On theological grounds, as presuming upon the order of God, who had ordained that darkness should prevail whenever the moon was not visible at night.

(2) For legal reasons, as the taxes to pay for the street lighting would fall on some who had no use for outdoor lights.

(3) For sanitary reasons, as the gas vapors were harmful to delicate persons and the street lighting by leading people to stay out after dusk would inflict coughs and colds upon them.

(4) On moral grounds, as the artificial light would destroy the fear of dark, which deterred many an evildoer.

(5) As hampering the police, since the bright lights would make horses shy and thieves bolder (!).

(6) For national economy, as the resulting consumption of oil or coal would reduce the country's resources.

(7) On patriotic grounds, since a regular lighting of the streets would detract from the thrill of the festal illuminations on national holidays.

However, even such serious indictments did not avail and one city after another adopted gas for street lighting until Jablochkoff with his electric candle showed the superior possibilities of electric lamps for this class of work.

EARLY PROBLEMS IN ELECTRIC STREET LIGHTING.

Rarely have pioneers in any new line of business activity made permanent headway in the face of more varied and more serious problems than those which confronted the electric light people thirty years ago. First among these was the question of earnings, for the returns to be obtained from commercial lighting were speculative and in most cases the only large source of revenue for which a long advance contract could be obtained was the pay for street lighting. Consequently electric street lighting in its pioneer days was a means of making commercial electric lighting available for both stores and residences, a function which in most places has long been outgrown. To secure the street-lighting contracts on which the installing of the whole electric light plant hinged, many of the central-station men (echoing the claims made by manufacturers for their arc lamps) designated the candlepower of the proposed street lamps with the same recklessness which has since been characteristic of claims made for gasoline lamps and for the so-called "gas arcs."

No question was raised during those early days as to the desirable color of the arc, nor as to the quality of the carbons, for the users had "Hobson's choice" regarding them. Most lamp mechanisms were so jerky in action that they could not have given a steady light even with the purer carbons now available; besides, the wind blowing through the wide mouthed globes (which sometimes were omitted altogether) added to the unsteadiness of the light. The insurance people soon compelled indoor arc lamps to be fitted with gauze casings or screens over the globes to restrain the sparks from the carbons, which spark arresters also would keep insects out of the lamps. However, few outdoor lamps were fitted with them and the collection of dead insects in the glass globe often added to the deposit of carbon and dust on the same so that a loss of twenty or thirty per cent of the light in passing through the globe was not uncommon.

But this loss of light was not taken seriously, for no attempts were made to measure the candlepower and the electric light people knew that the terms "2,000 candlepower" and "1,200 candlepower" were only nominal. The people whose streets were lighted knew that they were getting the powerful up-to-date lamps which raised their cities above the level of those still depending on the open-flame gas lamps, for Welsbach mantles had not yet entered into general gas practice. These big lights the electric light man was trying hard to offer at a price profitable for him and yet within reach of his town, where the people had not been educated to paying much for street lighting, and the amount available would not pay for running the lamps every night from dusk till dawn.

Various expedients were used to reduce this price, such as running the lamps only till midnight. Other plants cut down the running hours of their street lamps by omitting the times during which the calendar implied that the light of the moon should be ample, using moonlight schedules of which the most generally used ones were figured out by H. W. Frund, of Vincennes. Many plants saved energy also by reducing the current strength after midnight, aiming to give "full arcs" (2,000 candlepower) earlier in the night and "half arcs" (1,200 candlepower) after midnight.

Coupled with this question of price was the problem of making comparatively few lamps do for the lighting of an extensive city. The criterion of street lighting at that time was the light of the full moon, hence the natural effort on the part of many was to place a bunch of lamps high above the ground in imitation of a moon. Houses over three stories in height being rare, the tower system lent itself readily to the smaller cities and even did good service in many larger ones like New Orleans or Detroit. Thus the latter city had 150-foot towers with four lamps each, a few 175-foot towers with six lamps each being placed at central points, making a total of 719 lamps for lighting an area with over 2,000 street intersections.

While this tower system was taken up in many and widely scattered American cities (in some of which it still has strong advocates, although the increasing height of buildings works more and more against its effectiveness) it did not get a foothold in Europe, although there was a strong movement at one time for lighting Paris by this plan. As a feature of the world's exposition of 1889 two Frenchmen proposed a 1,000-foot stone tower supporting a ring of 100 lamps with a total of 19,000,000 candlepower; which, with special reflectors over them, were to light all of Paris. Owing partly to the frequent fogs and partly to the immense amount of energy required, this plan was abandoned and the original lamp-post function was omitted from the tower for which the design of Gustave Eiffel was chosen.

At the operating end there had been the problem of running many lamps from a single dynamo, the solution of which problem by Charles F. Brush had given us the commercial arc lamp. Then came the question of running lamps all night, since the seven-sixteenth-inch carbons in the open arc lamps would burn only seven or eight hours. Brush solved this with his double-carbon lamp in which the second pair of carbons was switched into service when the first had burnt low. Warner brought out a similar lamp in which the current was shifted from one pair of carbons to the other every fifteen minutes, while others used larger carbons to increase the burning hours. Thus, one American maker exploited twenty-ampere lamps, while the ares in use at the Paris Exposition of 1889 consumed from eight to sixty amperes (the latter requiring one-inch carbons). Of troubles with lamps there were many, even though the mechanisms used in most American lamps were quite simple compared with those used in Europe, where racks and gear (or clock) feeds were generally adopted because of their gentler feed and hence steadier light.

Then there were line troubles in plenty, as the making of insulations to withstand even 2,000 or 3,000 volts was not highly developed and it was quite a common occurrence to waste part of the energy through grounds on the line. Indeed, as late as 1890 one of the ablest of the early arc-lamp users, M. D. Law, admitted that he had only within the last six months been regularly testing his lines to detect and locate grounds. This statement was made in connection with a long paper full of hints for curing troubles with arc lamps, based on Mr. Law's plan of numbering each lamp and keeping a record of its individual troubles. Another prominent arc-light man, W. W. Leggett, had shown in 1887 how common it was to expect leakages on arc-light circuits, when he argued in these words against placing them underground:

"If telephone and telegraph wires can be undergrounded, why cannot arc wires? The reason is plain: seepage or escapage can be supplied in the former by additional battery power, but an arc-light generator is a queer specimen of mechanics." Fortunately, similar insulation difficulties restrained the dynamo builders from offering generators for more than fifty or sixty lamps, thus keeping the voltage down to a point where the grounds rarely had dangerous effects.

Considerable of the energy not lost by these grounds was wasted in heat at poor contacts in the switches, lamp hooks, wire joints, etc. As late as 1891 Elihu Thomson reported that a gain of two or three lamps in the capacity of a fifty-light dynamo could often be made by improving the contacts of switches, hangers and joints; also, that improving the insulation of the line often had a similar effect in adding to the apparent capacity.

With lamps not on towers, the methods of support varied from pole-tops and mast-arms holding the lamps ten to twenty feet from the pole, to center-suspension pulleys. Then, as now, most of the arcs were placed lower than a due regard for the distribution of the light or the avoiding of glare would dictate. This was partly because the lights were a novelty, so that the public wanted to see not merely the lighting effect of the lamp, but also the light itself—a demand which in many places still interferes with the proper use of lamps for outdoor as well as indoor lighting.

In time the reckless designation of lamps by a fictitious candlepower rating introduced another serious problem, viz., that of living up to street-lighting contracts calling for lamps of 2,000 or of 1,200 candlepower. The spoiling of revenues for gas companies and the friction due to politics in many cities led to a scrutinizing of lighting contracts and to legal battles of which the one at Colorado Springs was the most notable. These controversies were avoided abroad, where contracts were based on the wattage at the lamps and not on any assumed candlepower, a practice which reduced the likelihood of disputes though not entirely fair to the cities, as the effective street lighting may vary greatly with different lamps consuming the same amount of energy, and it was really illumination, not power, for which the cities were contracting.

While the old clamor for the "subdivision of the arc light" had been met by Edison with his incandescent lamp, the low voltage at which this was practical made the line loss too great to allow incandescent lamps to be scattered for any distance on multiple circuits. Brush's plan of using the incandescents in groups of five on series arc circuits did not give satisfaction, but the lamps built by Bernstein for use singly on 6.8 or 9.6-ampere arc circuits allowed incandescent street lights to be scattered over long distances. In the New England states the Thomson-Houston Company introduced similar series incandescent systems run separately from the arc lamps at much lower amperage from 1,000 or 1,100-volt direct-current generators. Heisler opened the way for still longer incandescent street-lighting circuits with his dynamo, which delivered two alternating currents of five amperes each at voltages of from 1,120 to 3,500 volts, according to the size of the machine. In 1889 the thirty-four-mile circuit lighting Ottawa, Ill., from a Heisler dynamo was believed to be the longest electric light circuit then in existence. But by this time alternating generators and transformers were being perfected, thus solving the problem of the economical distribution of current for incandescent street lights.

(To be continued.)

Lighting in An English Village.

An account in the *London Daily Mail*, describes an electric installation in the old English town of Anisworth in which electricity is now used not only for lighting but for numerous power purposes. While this village does not generate its own power, it does secure it on a co-operative basis, it being one of a number of places supplied from the town of Radcliffe.

The company is wiring cottages at a cost of about $4.00 each, putting in four lights with the understanding that the lighting bill will not exceed $6.50 per year for each cottage. The average cost of a twenty-five candlepower lamp on a farm is put at $1.00 per year.

In order to cut down the expense of line construction as much as possible, the wires have been strung along walls, doing away with poles where possible.

Meeting of Ohio Society.

The next semi-annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in Youngstown, O., on May 18 and 19. Oscar F. Rabbe, of Toledo, is president of the society and Frank E. Sanborn, of Columbus, is secretary-treasurer.

TELEPHONY—TELEGRAPHY, and WIRELESS.

The Facts of the Great Telephone Romance.

Under the title, "Facts of the Great Telephone Romance," the *Bankers' Magazine*, New York, for March, has published a most interesting summary of the story of the investment in the Bell telephone. So often is the development of the telephone business pointed to by parties interested in the promotion of certain securities as a criterion upon which to base a promise of rich return, that this study is refreshing and highly instructive:

The first stage in the evolution of the telephone business ended on March 7, 1876, when the fundamental patents covering the telephone and the art of telephony were granted to Alexander Graham Bell.

The second stage began when those who had aided Professor Bell in his experiments began to consider the commercial possibilities of the new invention.

The money which had been used to defray the cost of the experiments had been furnished by Thomas Sanders, Gardiner G. Hubbard and Professor Bell, and these men, associated as partners, were the joint owners of the patent.

After the successful exhibition of the telephone at the Centennial Exposition in 1876, Professor Bell gave a series of lectures in different places, seeking to interest the public in the art of telephony and capitalists in the commercial development of his invention. This continued until the summer of 1877, when an association was formed to take over the patents and develop them. This association was composed of the original partners, with the addition of Thomas A. Watson, who had been Professor Bell's assistant in his experiments.

This Bell Telephone Association had for its president Mr. Hubbard, with Mr. Sanders as treasurer, and continued until 1878, when two companies were formed.

In the spring of that year the New England Telephone Company (not the present one) was formed with a capital of $200,000. This company had for its purpose the development of the Bell patents in New England and it paid to the association for the use of those patents $100,000 of its stock and sold the remainder for $50,000 in cash, a portion of which was paid for the property in New England belonging to the association. The officers were: Gardiner G. Hubbard, president; Thomas Sanders, treasurer; C. E. Hubbard, clerk; George L. Bradley, general agent, and T. B. Bailey, chief clerk; but soon after its organization, Mr. Sanders was made president in place of Mr. Hubbard, and Mr. Bradley the treasurer.

ORGANIZATION OF THE BELL TELEPHONE COMPANY.

In July, 1878, the Bell Telephone Company was organized for the purpose of controlling the telephone patents in the United States outside of New England. It had a capital stock of $450,000, of which $300,000 was paid to the association for the inventions and $150,000 was paid for the telephone property in the territory. Mr. Hubbard was the first president of this company, but was soon succeeded by William H. Forbes. Mr. Sanders became the first treasurer, but was later succeeded by Mr. Bradley. Theodore N. Vail was general manager and R. W. Devonshire, accountant and auditor. Headquarters were established in New York City and from there the brunt of the work was carried on during the winter of 1878-1879.

In February, 1879, the New England and the Bell companies were consolidated under the name of the National Bell Telephone Company, having a capital stock of $850,000. The National Bell Company exchanged $650,000 of its stock, share for share, for the stock of the two earlier companies (the New England and the Bell Telephone Companies), and $200,000 was left in the treasury for the future use of the company. This treasury stock was sold from time to time and the records of the price received show the increasing interest in the telephone. Starting at $50 a share it rose to $100 in May, $112.25 in June, in July some was sold at $135 and in September the price was $227.50.

ABSORPTION OF THE TELEGRAPH INTERESTS.

While the telephone company was slowly developing its business the Western Union Telegraph Company, which had originally put little faith in the telephone invention, waked up to its growing importance and established at a number of points telephone exchanges in competition with those of the Bell Company. Negotiations between the two companies led to the agreement of November 10, 1879, by which the telegraph company withdrew from the telephone field, and as soon as this agreement was reached the shares of the telephone company rose rapidly in price.

In December, 1879, the company sold the last 500 of the 2,000 shares of treasury stock at $600 a share. The whole 2,000 shares of treasury stock brought into the treasury $430,000. A little later the price of the shares of the National Bell Company touched $1,000 a share. The growing interest in the telephone and the telephone business not only enhanced the price of the shares, but largely increased the demands for new capital.

To give the original adventures and inventors some share in the increased value, and to raise the necessary capital for further extension, the American Bell Telephone Company was formed in 1880 under a special charter granted by the Massachusetts General Court. This new company bought all the rights and property of the National Bell Telephone Company, paying for them $5,100,000 in shares, or at the rate of six shares of the stock of the new company for one of the old company, or at the same rate as was paid in cash by the purchaser of the last lot of treasury stock.

The American Bell Company proceeded with the development of the telephone business of the country on the broad lines originally laid out. The original owners and promoters of the telephone were first of all business promoters. Whatever reward they expected or received was the legitimate reward following a legitimate development of a substantial and beneficial business.

The Bell system was founded on the broad lines of "One System, One Policy, Universal Service," on the idea that no aggregation of isolated independent systems, not under common control, however well built or equipped, could give the public the service that the interdependent, intercommunicating, universal system could give.

This is no recent or new idea or theory. It is co-existent with the business; in fact, the theory was evolved and developed before the business, and the business has been developed on that theory. To expand the business it was first necessary to develop the "art." It was unique, nothing like it existed; the whole art of the practical application of electricity was new and undeveloped.

In the promotion and exploitation of the business two methods were possible, one company covering the whole country. This would require a large executive and administrative staff in the field, and a large capital, which, at the time, it was impossible to secure. Under this method, state organizations would also have been necessary to hold franchises. The other was to enlist a large number of individual workers, each with some capital, large faith and expectation, with great capacity for work, who would cover the field and develop the business.

REGARDING LICENSES.

To insure a common policy and central control, all licenses were issued for small units or territory under restricted terms, confining the business entirely within each territory. The parent company owned and furnished the telephones, had all reversionary interests or rights in the territory, and the right to connect the units with each other for the purpose of forming a universal intercommunicating telephone system For this purpose the long-distance lines and other toll lines were built. Under these temporary licenses certain rentals, so-called, or royalties, were paid to the parent company for the use of the telephones and other inventions owned, and also as compensation for the many other services rendered. When these licenses were made permanent and included all future as well as all existing inventions, and the right to the business within the units of territory, the parent company retained an interest in the business which was represented by a stock interest in each company.

These licenses called for a continued certain percentage of the stock of the company, but this right was soon waived by the parent company.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY.

By 1899, it was found that the demands of the business required a much larger capital than could be provided under the corporate powers of the American Bell Telephone Company. The American Telephone

and Telegraph Company, a company organized to operate long-distance traffic, purchased the American Bell Company on the basis of two shares of the latter company for one share of American Bell stock.

From its organization up to 1899, the American Bell Company had issued about 200,000 new shares of stock, which were sold at various prices; those issued before 1894 being sold to the stockholders at par, and those issued between 1894 and 1899, being sold to the stockholders at various prices, some as high as $225 a share, so that in 1899 the par value of the outstanding capital stock was about $2,000,000 less than the actual cash which had been paid into the treasury of the company.

If we sum up the financial results, we find that the original association received from the operating companies $400,000 in stock to pay for all expenditures and for the inventions, which represented the work of several years and the expenditure of about $50,000 in cash. If this stock had been sold at the highest price at which any considerable sales were made in the winter of 1879-1880, it would have realized less than $4,000,000 in cash. If it was kept, it would have received in American Bell Telephone stock in 1880, $2,400,000, which, if sold at the best prices, might have realized from $5,500,000 to $6,000,000. If kept until the sale of the American Bell to the American Telephone and Telegraph Company, the holder would have realized $4,800,000 in stock.

There was never any considerable amount, if any, of the stocks of these operating companies sold at less than $50 per share. The total amount of stock sold at less than $100 a share, not including any of the $400,000 stock which went to the original association, was in all 3,175 shares, $317,500 par. These shares received the same benefits, of course, that the other stock received and might have yielded $4,000,000 if it had all been sold at the best prices.

If the holders of the $400,000 stock paid for the inventions and development to 1878, and the $317,000 sold by the treasury at par or less, had been sold at the top of the market—for any considerable sales, the $717,500 stock would have realized less than $12,000,000.

These are the facts of the great telephone romance. They have been multiplied, distorted and made the basis of misleading statements by promoters, reputable and otherwise, who were after the credulous investor. One of Prof. Bell's original associates called the attention of the maker to one of these misleading prospectuses—a reputable brokerage firm—and the only satisfaction he got was the statement: "We are brokers, not historians." Another fact should be emphasized—that is, that the original capital of the Bell association was $500,000, and the par value $100 and the percentage of increase was on that sum—not ten or twenty times as much capital or on a par of $5 or $10 a share.

Telephone Rates in Germany.

A committee of the German Reichstag has recently drawn up a new schedule of rates. At present a telephone in Berlin costs, for unlimited service, $42.50 per year. Another rate is $23 plus 1.25 cents per call. Under the new regulations the charge will be $23, plus $17.80 for service limited to 2,000 calls per year, or $33 with a limit of 4,000 calls. If preferred, one cent per call may be paid in addition to the fixed charge.

Earth Currents and the Telegraph.

When a single line is connected to earth at its ends, it is traversed by an earth current, whose magnitude is usually less than 0.1 milliampere but may be much greater at times of magnetic storms. Researches have shown, according to a writer in the *Elektrotechnische Zeitschrift* the following facts in regard to earth currents:

(1) Wires running north and south experience stronger currents than those running east and west.

(2) The currents are less, the shorter the line.

(3) The currents undergo periodic variation, the daily and yearly fluctuations following those of the earth's magnetic field.

(4) Unusual fluctuations of the earth currents accompany unusual disturbances in the earth's magnetism.

The customary earth currents do not interfere with telegraphy upon a grounded circuit, because even the most sensitive relay requires a current of two milliamperes. In times of severe disturbance, however, the interference may be very troublesome, and even prevent the transmission of dispatches. In that case, two earth-return circuits may be combined into a single ungrounded metallic circuit, or two metallic telephone circuits may be combined to yield one telegraph circuit without interfering with its use for telephony. One telegraph circuit can also be constructed from one telephone circuit and one ground-return circuit. If two telephone circuits are already phantomed, they can still be used for a metallic telegraph circuit if there is available also a ground-return telegraph wire.

Automatic Telephones in Cuba.

The Automatic Electric Company of Chicago has secured a contract in Cuba to install 8,500 lines. The original contract called for 6,000 lines, but 2,500 additional lines were found necessary. The automatic telephone is now being used widely throughout this country as well as abroad.

Wireless in South America.

Peru, Chile, Uruguay and Argentine Republic have decided to make wireless telegraphy a Government monopoly. Telefunken equipment has been ordered. Similar equipment will be used in Brazil.

Interstate Commerce Commission Ruling on Telegraph and Telephone Companies.

The Interstate Commerce Commission has announced that all telegraph and telephone companies doing an interstate business will, in the future, be regulated by the interstate commerce act and that all these companies must file their tariffs or rates on interstate business, and will be held liable for discriminations.

Following is the announcement of the Commission:

"(1) That each and every telegraph and telephone company which transmits messages over its lines or line from a point in one State, Territory or District of the United States to any other State, Territory or District of the United States, or to any foreign country, is subject to the provisions of the Act.

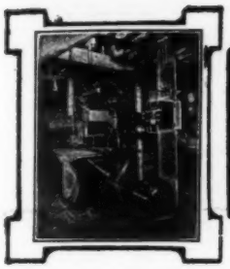
"(2) That if a telegraph or telephone company, the line of which is wholly within a single State, Territory or District of the United States, received a message within such State, Territory or District of the United States, for transmission to a point without the State, Territory or District, which it transmits over its line to another point in the same State and there delivers it to an interstate line for transmission to destination, the first-named company, by virtue of its participation in this transaction, is not made subject to the provisions of the Act; unless there be an arrangement between that company and its connection for through continuous transmission of such messages, in which latter case all of the participating companies in such through continuous transmission are subject to the provisions of the Act.

"(3) If two or more lines are connected so that a person within one State, Territory or District of the United States talks with a person at a point outside such State, Territory or District of the United States, or so that a message is transmitted directly from a point within a State, Territory or District of the United States to a point without the same, the transmission of messages in this manner constitutes interstate commerce and brings all of the participating lines within the purview of the Act.

"(4) It follows that telegraph and telephone companies subject to the Act, as above indicated, must conform to the provisions of Section 1 thereof, requiring that all of their rates and charges for the transmission of interstate messages shall be reasonable and just, and that such companies may lawfully issue franks covering free interstate service or may grant free interstate service to the same extent, and subject to the same limitations, as other common carriers under the provisions of said section.

"(5) Such telegraph and telephone companies subject to the Act are also governed by the provisions of Section 3, forbidding any undue or unreasonable preference or advantage by rebates or otherwise, or any undue or unreasonable prejudice or disadvantage in any respect whatsoever, and are subject to the lawful orders of the Commission made pursuant to the provisions of Section 15 of the Act, and also of Section 20 thereof respecting the keeping of accounts and memoranda and the making of reports to the Commission.

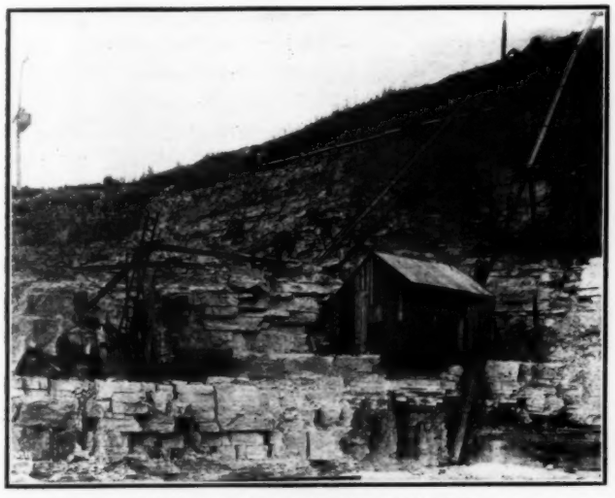
"The Commission at this time withholds expression of its views regarding other questions which have arisen with respect to the amenability of these carriers to the provisions of other sections of the Act."



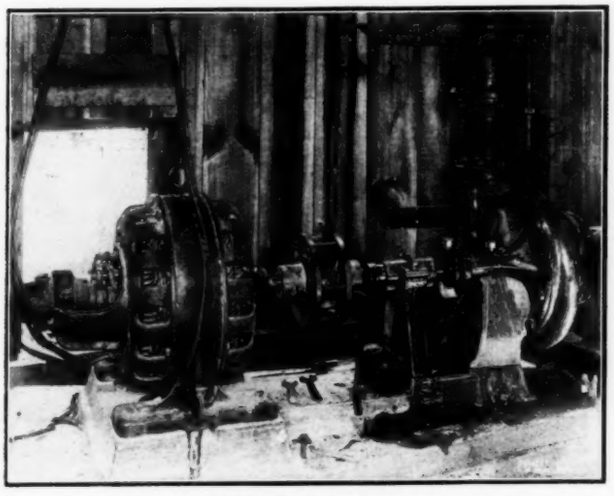
Industrial Power

Electric Pump Replaces Steam Pump in Stone Quarry.

The view of the quarry given herewith shows a steam engine partially dismantled and left to rust out its days in the weather, also the shanty in which the new pump is installed and the suction and delivery pipes. The view inside the shanty shows the motor and the pump, installed across the end of the shanty close to the suction and delivery pipes. As the motor is about two and one-half feet high, an idea may be had of the relative sizes.



INSTALLATION AT STONE QUARRY.



MOTOR-DRIVEN PUMP.

This outfit, consisting of a No. 6 high-duty American centrifugal pump driven by a thirty-horsepower Westinghouse alternating-current motor running at 690 revolutions per minute, was installed over a year ago by the Kankakee Electric Light Company, in the stone quarry of McLaughlin & Mateer, Kankakee, Ill., to keep the quarry dry and has been giving excellent service ever since.

The pump delivers 1,100 gallons per minute against a discharge head of fifty-five feet and a maximum suction lift of twenty-five feet pumping the water from the quarry sump. The water is started and stopped by a ball float and master switch in the pump house and a magnetic starter on the bank above the quarry. The pump works automatically, running eight hours out of the twenty-four; that is, the sump fills in one hour, and the pump empties it in a half hour.

The owners of the quarry were somewhat skeptical of the powers of the pump when it first appeared on the scene, and called it a "toy," and it did look diminutive beside the steam pump. When the pump was connected and ready to work they came around confidently expecting that this new device would be totally inadequate and that the engineer was going to "get in wrong." But when the equipment dug right into the load and pumped water in a large stream and never once hesitated until the sump was emptied, their surprise and speedily their pleasure was great. So pleased were they that in twenty-four hours after the pump began work orders were given for the complete abandonment of the steam equipment.

The motor application is a particularly good one. The first point of excellence is the use of a flexible coupling between the pump and the motor, which permits slight inaccuracies in the alignment of the two shafts. Some form of flexible coupling should preferably be used on all installations where the motor is direct connected to any two-bearing machine. The second point is the excellent concrete foundation provided even though the pump and motor are mounted on the same cast-iron bed plate.

Electric Steel From Scrap Iron.

A company has been formed in Norway for the purpose of utilizing scrap iron and steel in the electrical production of steel. Broken-up vessels, machinery and all available scrap will be treated in an electric furnace. A steel foundry and rolling mill will be included in the works. The power available is 2,500 horsepower, but it can be increased to 10,000

Hydroelectric Development in Sweden.

During 1910 twenty new hydroelectric plants were built in Sweden, and five were reconstructed, representing altogether 111,000 horsepower. There are at present under construction projects which will furnish 115,000 horsepower additional. One of those already built and one under construction are Government projects and together represent 90,000 horsepower.

Electricity in a Composing Room.

The *New York World* has the most complete electrical equipment in its press and composing rooms of all the newspapers in New York. Electricity is used not only for lighting and to operate the presses and linotypes, as is the custom in all first-class offices, but the *World* has gone one step further, and melts the type metal in the linotype by electrical heat.

This innovation is commended both by the executive staff and the linotype operators. The electric heating has increased the efficiency of each machine about twenty per cent, while a much better "slug" is made by melting the type metal electrically than by the older method. This is because electric heat is absolutely under control, and better distribution can be effected.

To the uninitiated the linotype machine, which costs from $3,000 to $3,500, resembles a typewriter keyboard at which the operator sits. In response to his fingers, the type drops down, and when a line is filled, this travels to the mouth of the melting pot, where it makes an impression on the type metal. The letters are then returned automatically to their respective boxes.

Each line of type, in type metal, is called a slug, and it is of these slugs that the pages of the papers are made up. When any page is complete it is put in the "form," so-called, and at high heat and heavy pressure a "matrix" impression is made. Because of the heavy weight which must be placed upon the forms, it is necessary that the "slugs" be perfect, and it is here that the electric melting shows to advantage. When electricity is used, the melting pot can be kept at exactly the right temperature to make a perfect mold, whereas, under the old method. the metal frequently became too hot, producing what is called a "porous slug," or one with air bubbles in it.

When one of these imperfect slugs is put under the tons of pressure used to make the matrix, not uncommonly it breaks. In this case the entire form has to be knocked to pieces, a new slug made and inserted for the defective one and the form locked up again. It can easily be seen that this small catastrophe might happen at most inopportune moments for a newspaper, for instance, when some big story was being "rushed" to catch an edition. At best it causes a considerable waste in the time of high-priced linotypers. Since electric melting pots were put upon the fifty-six linotypes of the New York *World* not a single form had to be remade for imperfect slugs.

While the more perfect performance on the part of the electric melting pot wins the approval of the publishers, the new apparatus has greatly improved working conditions in the composing room. Where other than electric heat is used for the melting pot, not only does the air become very much overheated, but the fumes from the type metal vitiate the air, so that working in this close hot atmosphere tends to cut down the speed of the machines, and finally to undermine the health of the operators.

The electric melting pot is provided with a cover and spout and surrounded by a jacket of cast-iron lined with asbestos. A centrally-arranged plunger serves to force the molten metal out of the spout in the customary manner. A number of heating coils of a desired grouping and supported by insulators are placed in the air-tight space between the melting pot and the jacket. Heating coils of high resistance are placed outside and around the insulating sleeves. The coils are divided so that the heat from one group is applied to the main portion of the pot and from the outer group to the spout, so that the greater amount of heat energy is used for melting the metal and a lesser amount for keeping it in a molten condition. Heat control, provided by a thermostat, keeps the metal at the right temperature.—*Edison Monthly.*

Yarn Singeing by Electricity.

Another triumph of electricity in textile manufacture has to be recorded. The singeing of yarns has hitherto been carried on by the process known as "gasing." But with this operators have to contend against difficulty of control and fouling of the air. A machine for yarn singeing by electricity has now been introduced. The actual burning takes place in an insulated platinum-alloy tube, electrically connected. The fluff and upstanding fibers are quickly removed, without in any way damaging the yarn itself. The process is quick and clean, and, of course, gives off no evil fumes.—*Electrical Engineer.*

Subway Bids Withdrawn.

The bid for the construction of the New York subway which was submitted by Frank J. Sprague and Oscar T. Crosby has now been withdrawn following a statement by Mr. Sprague and Mr. Crosby that their proposal had not received proper consideration.

After writing the Public Service Commission and the Conference Committee and receiving no reply from either, a letter was written to Mr. McAneny by Mr. Sprague asking whether or not it was the intention of the committee to consider the independent proposal which had been submitted, and asking for an early reply. This letter also was unanswered.

In a later letter to William R. Willcox, chairman of the Public Service Commission, Mr. Sprague and Mr. Crosby withdrew their proposal, but stated that they were prepared at any time to bid for the equipment and operation of any independent line which appeals to their judgment.

Rubber Imports from Mexico.

The invoices of the United States consul in the district of Torreon, Mex., show that during the period from January 23 to February 14, 1911, there was shipped to the United States 1,567,500 pounds of crude rubber. The recent inauguration of three new guayule rubber factories in the Torreon district is expected materially to increase the output of the product as soon as the present disturbed conditions of the rural localities from which the supply of shrub is drawn subsides. One of these new factories is at Monclova, another at Port Carmen and the third at Gomez Palacio.

Electric Railway Equipment.

An order has been placed with the G. C. Kuhlman Car Company for eight pay-as-you-enter cars by the Utica & Mohawk Street Railway. The Cincinnati Traction Company and the Buffalo & Lake Erie Traction Company are in the market for fifty and twenty-five of these cars, respectively.

The Cambridge Subway.

The Cambridge subway, which connects the city of Boston with Harvard University, is now practically completed and trains will be running in a few months. The total length of the tube is three and one-half miles.

MEMBERSHIP IN THE COMMERCIAL SECTION, N. E. L. A.—I am connected with a firm that manufactures electric signs. Am I eligible for membership in the Commercial Section of the National Electric Light Association, and, if so, what must I do to become a member?—F. L., Chicago.

Any Class B or Class E member of the National Electric Light Association is eligible for membership in its Commercial Section. The Class B membership of the Association includes employees of member central-station companies, while membership in Class E is open to any employee of an electrical manufacturing company, jobber, dealer, professional engineer or publisher. To anyone now holding either a Class B or Class E membership in the National Electric Light Association the dues of the Commercial Section are $2.50 per annum in addition to the regular Association dues. To those not holding personal membership in the Association the dues are $7.50 per annum, which includes a Class B or Class E membership. Application blanks and detailed information regarding the benefits of membership in the Commercial Section may be obtained from J. Robert Crouse, 1823 East Forty-fifth Street, Cleveland, O., who is chairman of its Membership Committee, or from any member of this committee, or from the executive secretary of the Association, T. C. Martin, 33 West Thirty-ninth Street, New York, N. Y.

MONORAIL SYSTEMS.—In a monorail system, such as Brennan devised, that is operated by electricity, is it necessary to have separate motors for driving the gyroscope and for propelling the car? If the power should fail, would the car tip off the rail?—W. R. S., Enid, Okla.

It is practically necessary to have separate motors for the two purposes specified, since the gyroscope motor must run at constant and high speed and the propelling motor must necessarily start and stop at various stations and be capable of running at variable speed. The gyroscope motor need be only a small motor, probably of the shunt or cumulative compound type, which must be provided with control devices to enable it to start at very low speed and to accelerate gradually. The construction of the gyroscope requires a high grade of workmanship and ball bearings to reduce the friction to the minimum; in fact, it has been proposed to run the gyroscope in a vacuum. As a result the gyroscope can run for hours after its driving power is cut off. Therefore there is little danger from any interruption of the power. To eliminate all fear from such a possibility a storage battery could be carried to supply the gyroscope motor for a long time.

LIFE OF IGNITION STORAGE BATTERIES.—A friend told me that the storage battery he has used for sparking on his gasoline car was found to be short-circuited and its plates almost completely disintegrated after a little less than a year's use. He claimed he had had the battery charged and regulated once a month at a garage. To me it seems that the battery should last longer than that with fairly regular treatment. Is one year the average life for such a battery?—E. H., Evanston, Ill.

The life of an ignition battery depends upon its make and still more upon the care exercised in using and in charging it. If given regular charges and discharges closely following each other as in a laboratory test or under ideal road conditions, such batteries are found to have a useful life of 200 to 400 complete charges and discharges. In actual service, however, an ignition battery is subjected to a great deal of abuse, particularly at the hands of careless chauffeurs and garage attendants; it is left standing in a highly discharged condition for long periods; when charged it is likely to be undercharged or overcharged at a high rate; the specific gravity of the acid is not kept at the proper point, also the level of the acid; it is frequently overdischarged. All these things cause the formation of an excessive amount of sulphate or rapid disintegration of the plates, both of which, along with the constant vibration while on the road, materially shorten the useful life. With a reasonable amount of intelligent care, automobile ignition batteries are found to give good service for 70 to 100 complete charges and discharges; in other words, greatly in excess of a year.

MAGNETS AND MAGNETIC INDUCTION.—(1) Can permanent magnets be made as strong in the shape of a bar as in the horseshoe shape? (2) Would it be practical to revolve a bar magnet in an iron ring fitted with coils to produce current? (3) With such an arrangement would the magnet remain permanent?—W. R., Detroit, Mich.

(1) Bar magnets can be magnetized as strongly as horseshoe magnets, but the density or strength of field between the poles of the latter is, of course, greater, as can readily be demonstrated by sprinkling fine iron filings on a glass plate over the magnets.

(2) It is possible to do this, but not very practical, as the electromotive force developed would be too feeble except for demonstration purposes. This general principle is practically employed in the revolving-field alternator, but in this machine an electromagnet is revolved that is many times as strong as a permanent magnet of equal size; moreover the coils are placed in slots in the inner circumference of a laminated ring, thus reducing the air gap, reducing the eddy-current losses and utilizing both sides of the coil effectively. (3) If the magnet had previously been aged or properly permanized, it would not suffer any demagnetization from such use. If it had not been aged and the circuit of the coils had been closed, the magnetic flux from the latter would have weakened or partly demagnetized the magnet to its state of permanency.

QUARTZ MERCURY-VAPOR LAMPS.—Who are the makers of quartz-tube mercury-vapor lamps in this country?—S. M. F., Columbia, Mo.

These lamps have not yet been commercially manufactured in this country. There are several makers in Great Britain and Germany.

BOOK REVIEWS.

"Elements of Electricity." By W. H. Timbie. New York: John Wiley & Sons. Cloth, 556 pages (5 by 7.5 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.

This book, designed primarily to meet the needs of those who desire to follow an occupation connected with the electrical industry, is based upon a series of lectures given in the Pratt Institute. The treatment is elementary and necessarily brief, as a great amount of ground is covered. The text is confined to an adequate treatment of a few fundamental ideas rather than a discursive treatment of many. Therefore it includes only ideas of the elementary principles of direct and alternating-current generation, distribution and utilization in light and power. The book contains an adequate amount of information concerning electrical laws and practice in an immediately usable form; it applies the information contained to real things and not to abstract theory and conditions; it will develop in the student a capacity for applying what he has learned, the large number of diagrams aiding materially in providing exact and clean-cut conceptions of the conditions of the problems; it presents, out of the great mass of electrical phenomena, only those facts and principles which a technical student needs to know. In the appendix is given a large number of mathematical formulæ and rules covering all branches encountered in the text.

"Electric Wiring, Fittings, Switches and Lamps. By W. Perren Maycock. New York: Whittaker & Company. Cloth, 628 pages (4.5 by 7.5 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.

This book deals, in a comprehensive manner, with the uses of electrical energy by the ordinary consumer. The various ways in which the different appliances or current-consuming devices may be connected to their switches, etc., are explained very fully. Starting from the point of entry of the supply mains into a building, the various methods of planning and arranging the circuits; the placing of such accessories as switches, ceiling rosettes, plug connections, etc., and the connections of lamps, heaters, bells, small motors are fully explained. The book is essentially a source of practical information for central-station men, contractors, wiremen, builders and students.

"Motion Study." By Frank B. Gilbreth, New York: D. Van Nostrand Company. Cloth, 116 pages (5 by 8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.

This work is the result of long and close observation of the laws of motion as applied to industries and occupations. The aim of motion study is to find and perpetuate the scheme of perfection. There are three stages in this study: (1) Discovering and classifying the best practice; (2) deducing the laws; and (3) applying the laws to standardize practice, either for the purpose of increasing output or decreasing hours of labor, or both. In this book, by means of an analytic treatment of the laws involved the author shows the necessity for motion study and the savings that are possible by the application of its underlying principles.

"The Electrical Nature of Matter and Radioactivity." By Harry C. Jones, New York: D. Van Nostrand Company. Cloth, 210 pages (5 by 8 inches). Supplied by the Electrical Review Publishing Company, for $2.

This is the second edition of this book, the contents of which have appeared as a series of articles in the ELECTRICAL REVIEW. The aim of the author has been to present to the reader the more important facts and conclusions in connection with the work on the electrical nature of matter and radioactivity as far as possible in non-mathematical language. While this work is written in a semi-popular style, the attempt has been made to treat the subject with scientific accuracy, and the facts presented have been taken from original sources.

"Brookes Automobile Handbook"—1911. By L. Elliot Brookes, Chicago: Frederick J. Drake & Company. Flexible morocco, 701 pages (4.5 by 7 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.

This is a strictly up-to-date treatise, dealing in a practical manner with all of the various questions relating to the construction, care and operation of gasoline, electric and steam automobiles, including illustrated descriptions of the many different parts, together with clear and concise explanations of the principles governing their action. Methods are given for dealing with motor carburetor and ignition troubles. There is also given valuable information pertaining to ignition systems, carburetors, magnetos, etc. Valve setting is dealt with in detail, also indicator work, with numerous tables, useful rules and formulas and over 300 illustrations.

"Smoley's Tables." By Constantine Smoley. Sixth edition, revised and enlarged. New York: The Engineering News Publishing Company. Flexible leather, 174 pages (4½ by 7 inches). Supplied by the Electrical Review Publishing Company for $3.50.

This convenient book of tables contains parallel tables of logarithms and squares; logarithmic and natural functions of angles and in terms of given bevels, squares, cubes, etc. The argument in the main table is given in feet, inches and fractions of an inch. In this edition the angular functions are given for intervals of one minute, a valued improvement over the previous ten-minute intervals. The addition of tables of squares, cubes, roots, reciprocals, area and circumference of circles, etc., add much to its value. The book is well printed.

"How to Make a Wireless Set." By Arthur Moore. Chicago: Popular Mechanics Company. Cloth, 84 pages (4.5 by 6.5 inches), illustrated. Supplied by the Electrical Review Publishing Company for 25 cents.

This handbook is adapted for amateurs and those desiring practical information relative to the building of wireless telegraph sets. The text is easily understood and is supplemented with numerous drawings and photographs, illustrating the design, construction and finished appearance of each part.

"Electricians' Operating and Testing Manual." By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Company. Flexible leather, 352 pages (4½ by 6½ inches), illustrated. Supplied by Electrical Review Publishing Company for $1.50.

The object of this volume is to instruct the practical electrician in the management, operation and testing of the more important electrical devices now in use, including dynamos, motors, transformers, batteries, lamps, etc. The method adopted has been to familiarize the reader with underlying principles rather than to go into details of construction of particular commercial forms. The book is therefore rather elementary in character, dealing principally with the fundamentals. The illustrations are mainly line drawings, and all catalog cuts have been omitted. A chapter is devoted to dynamo and motor troubles, a list of the principal troubles likely to be encountered, with a method of testing for each, being enumerated.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

WEST PENN TRACTION COMPANY.

The West Penn Traction Company has issued its report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Gross revenue	$2,107,002	$1,767,915
Operating expenses and taxes	987,642	981,340
Net revenue	1,119,360	786,575
Bond interest	470,504	459,827
West Penn Rwys. dividend	202,500	137,500
Surplus	446,356	189,248
Preferred dividend	97,500	.....
Balance	*348,856	189,248
Common dividend	65,000	.....
Yearly surplus	283,856	189,248

*Equal to 5.37 per cent earned on $6,500,000 common stock.

SUSQUEHANNA RAILWAY, LIGHT & POWER COMPANY.

The Susquehanna Railway, Light & Power Company report for the year ended December 31, 1910, compares as follows:

	1910	1909.
Net earnings of subsidiary companies, etc.	$600,485	$426,689
Amortization reserve	86,115	35,239
Preferred dividends	204,619	204,619
Retained surplus account subsidiary companies not declared in dividends	247,164	167,465
Surplus for year	62,596	19,553
Previous surplus	164,546	144,993
Profit sale of securities	67,942	.....
Total surplus	295,086	164,546

INTERNATIONAL RAILWAY COMPANY.

The report of International Railway Company (Buffalo), for the quarter ended December 31, 1910, compares as follows:

	1910.	1909.
Total operating revenues	$1,224,665	$1,158,196
Total operating expenses	699,126	678,535
Net operating revenues	525,539	479,661
Taxes accrued	75,587	66,729
Operating income	449,952	412,932
Other income	2,962	8,375
Gross income	452,914	421,307
Total deduction from gross income	208,867	206,042
Net corporation income	244,047	215,265

OTIS ELEVATOR COMPANY.

The Otis Elevator Company has issued its pamphlet report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
*Net earnings	$1,157,371	$1,048,689
Preferred dividend	381,109	378,600
Balance	†776,262	670,089
Common dividends	255,012	191,259
Balance	521,250	478,830
Depreciation	391,124	362,845
Surplus	130,125	115,985

*After deducting all charges for interest and patent expenses and for renewals and repairs for maintenance of plant.

†Equal to 12.2 per cent on $6,375,300 common stock before charging out current depreciation as compared with 10.51 per cent earned on same stock previous year.

President Baldwin says in part:

"The volume of business done for the year 1910 is somewhat in excess of the year 1909, and the profits are the largest in the history of the company. The outlook for the business in 1911 is not in some respects as favorable as it was last year, although the contracts closed up to this time indicate that there will be a fair demand for our product.

"The escalator, or traveling stairway, exclusively controlled by us, promises to become an important adjunct to our business. Substantial orders have been placed with us in the last few months for escalators for Europe and this country."

WINNIPEG ELECTRIC RAILWAY.

The Winnipeg Electric Railway Company has issued its report for the year ended December 31, 1910, which compares as follows:

	1910.	1909.
Gross revenue	$3,284,342	$2,023,731
Operating expenses	1,654,834	720,665
Net revenue	1,629,508	1,303,066
Fixed charges	694,739	439,661
Balance	*934,769	863,405
Dividends	600,000	600,000
Surplus for year	334,769	263,405
Previous surplus	861,430	598,024
Total surplus	1,196,199	861,429

*Equal to 15.58 per cent earned on $6,000,000 capital stock compared with 14.39 per cent earned on same stock last year.

MILWAUKEE ELECTRIC RAILWAY & LIGHT

The Milwaukee Electric Railway & Light Company and subsidiary companies' consolidated income account for the year ended December 31, 1910, compares as follows:

Nine months' surplus	690,141	788,211
	1910.	1909.
Gross revenue	$6,428,710	$5,709,946
Operating expenses, taxes and reserve	4,382,611	3,680,420
Net reserve	2,046,099	2,029,526
Interest charges	1,278,719	1,257,974
Balance	767,380	771,552
Preferred dividends	270,000	270,000
Surplus	497,380	501,552

ROCKY MOUNTAIN BELL TELEPHONE

The report of the Rocky Mountain Bell Telephone Company for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross revenue	$2,053,502	$1,855,689
Expenses	1,407,887	1,332,467
Net revenue	645,615	523,222
Charges and taxes	469,283	441,655
Surplus	176,332	81,568

Surplus earnings for 1910 and 1909 were charged to maintenance, and set aside as a reserve for depreciation of property.

UNION ELECTRIC LIGHT & POWER.

The Union Electric Light & Power Company of St. Louis has issued its report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Gross revenue	$3,371,520	$3,085,614
Operating expense, taxes and reserve	1,767,211	1,503,034
Net revenue	1,604,309	1,582,580
Interest charges	823,341	834,204
Balance	*780,968	748,376
Dividends	593,100	593,100
Surplus	187,868	155,276

*Equal to 7.90 per cent earned on $9,885,000 capital stock, compared with 7.58 per cent earned on same stock last year.

AMONG THE CONTRACTORS AND SUPPLY MEN

MARTIN & LAMPKIN, Jacksonville, Fla., have severed their connection with the Florida Electric Company and have opened a shop at 118 South Ocean Street. The firm is equipped to do all kinds of electrical work.

THE NEW STATE ELECTRIC SUPPLY & FIXTURE COMPANY, Phoenix, Ariz., has been awarded the contract for the construction of the new Orwood substation of the Phoenix Railway Company.

CHARLES H. SPANGLER, Waynesboro, Pa., purchased the business and equipment of the J. D. Schaff Electric Company in Hagerstown and will conduct a general electric supply and contracting business.

THE J. K. HOWE COMPANY, Baltimore, Md., received the contract for wiring and installing electrical fixtures in the building constructed by the Richmond Building Corporation on Main Street in Baltimore. The estimated cost of the work was $10,000.

THE WALKER ELECTRIC COMPANY, Rome, Ga., recently opened an electrical contracting office in that city. The company purchased the electrical supply department of the Rome Railway & Light Company, including the fixtures and stock.

THE SPANGLER ELECTRIC CONSTRUCTION COMPANY of Gloversville, N. Y., has been incorporated with a capital of $2,000 to do a general electric contracting business. The directors are Charles Spangler of Gloversville and Hida D. and Richard Spangler of Schenectady, N. Y.

THE BERNE SELLING COMPANY, of Albany, N. Y., has been incorporated with a capital of $6,000, and will deal in and manufacture lamps, burners, gas and electric fixtures, etc. The directors are Wm. D. Arnold, Chester A. Dwyer and George B. Wilkinson all of Albany.

THE ANDERSON-MARTIN ELECTRIC CO., of Brentwood, N. Y., is a firm which was recently incorporated for the purpose of doing electrical work of all kinds. The incorporators are Raymond S. Andrews, Brooklyn, and John B. Martin and Anthony H. Creagh, both of Brentwood.

New Electrical and Mechanical Apparatus and Appliances.

Portable Electrically Driven Radial Drill.

The accompanying illustration shows the new portable electrically driven radial drill being placed on the market by the Lamb Electric Company, Grand Rapids, Mich. The extreme height of this device is forty inches and the greatest distance from the spindle to the base is twenty-eight inches. The distance from the column which is two and one-half inches in diameter, to the center of the spindle is ordinarily eight and one-fourth inches.

The drill may be operated conveniently in any position vertically, horizontally or at any angle. The travel of the spindle is five inches and it is operated by a rack and pinion, which in turn is operated by a worm and gear, making a powerful feed. The spindle has a quick return when desired. These drills are regularly furnished in single and double-speed types. In the latter, the change from one speed to the other is instantly obtained by shifting a knob. The single-speed machine operates at a speed of 165 revolutions per minute and the two-speed at 165 and 230 revolutions per minute. The capacity of these drills, in steel, is one inch.

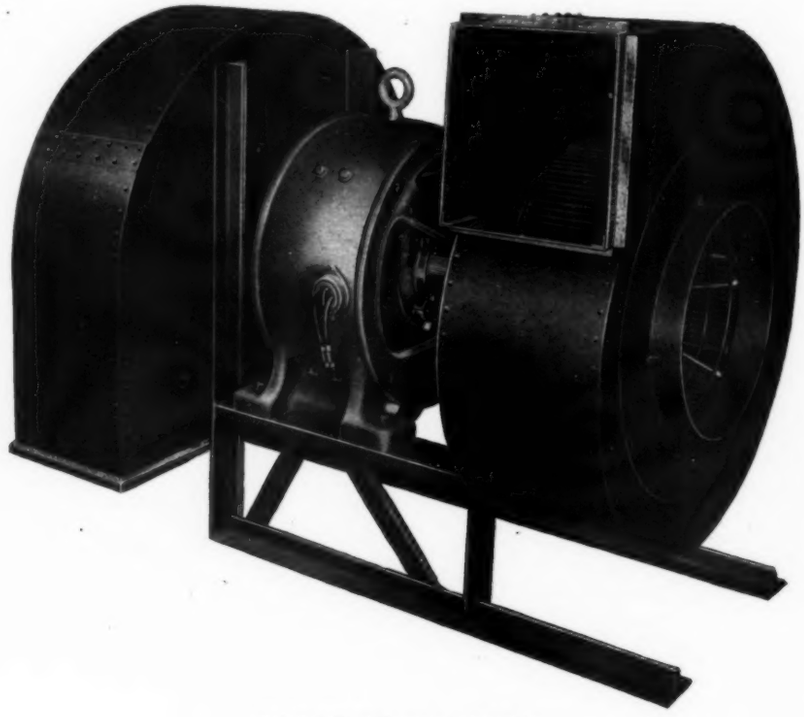
LAMB RADIAL DRILL.

Hackney Ventilators.

A subject which is justly being given serious consideration is that of ventilation. Its importance has probably been realized for many years, but the comparatively recent discoveries of scientists that much of the sickness and death can be traced to constantly breathing impure air has led to a more thorough appreciation of the value of ventilation and has given impetus to the design and manufacture of devices for producing ventilation.

This development has given rise to the question of how best to provide fresh air indoors without drafts or any other disagreeable features. The problem has been uppermost in the minds of engineers for several years and much experimenting has been done, with a fair measure of success.

Working on the principle that proper ventilation consists in introducing air into a building from out-of-doors, circulating it thoroughly but without drafts, and finally discharging it again without drafts, the Hackney Ventilating Company, of St. Paul, Minn., has perfected and placed on the market the electric ventilating set shown in the accompanying illustration.



HACKNEY VENTILATING SET.

The fundamental principle upon which the Hackney ventilator is based is shown clearly in the illustration. Two blowers are used, one forcing the air into the building and the other drawing it out. These two blowers must each handle exactly the same amount of air for perfect results and for this reason as well as on account of rigidity and compactness, they are both, ordinarily, mounted on a common base with the driving motor, to which they are directly connected. In special cases, however, other methods of assembling are employed.

Referring again to the illustration, it will be seen that the air inlets are on each side of the set. One blower brings in the fresh air and distributes it through piping to all parts of the room, the other blower draws the foul air from a corresponding system of piping and discharges it out-doors.

The Hackney ventilator can be applied to any building or structure. Its location is optional, it being possible to install the apparatus in basements or attics and connect it by means of suitable piping with the room or rooms

to be ventilated. In hotels, office buildings, etc., where provision has already been made for washing air, the Hackney ventilator may be installed in connection with the existing equipment with excellent results.

The machine shown in the illustration is now ventilating Schiek's Cafe in Minneapolis. Although it was designed to serve only 300 people, the management of the cafe states that very often the number of patrons in the building exceeds this number by 100 and the results are equally as good as when below the number provided for.

The machines are made in portable sizes suitable for private residences as well as in sizes suitable for ventilating theaters, hotels, public halls, etc. The motor is of standard make, its size and type depending on the conditions to be met. All material entering into the construction of these machines is especially selected for the purpose, and the manufacturers claim the workmanship to be of the highest quality.

MILLAR IRON SUPPORTED ON STAND AND USED AS ELECTRIC COOKSTOVE.

The Millar Household Devices.

In the accompanying illustrations are shown three new Millar heating devices for the household which embody many commendable features of design. The Millar domestic irons are all double-pointed and the unit so arranged as to give a maximum, even heat at the points and around the edges. The handle is corrugated to prevent slipping or any hardening of the hands from use, and is mounted in such a way as to allow the circulation of air between the iron and the steel handle, keeping it always cool.

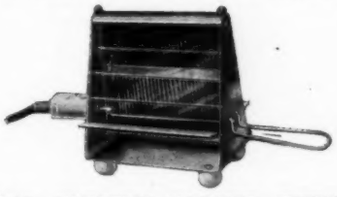
A novel feature is the attachment of the cord at the side of the iron opposite to the operator, thus keeping it always out of the way. The suspension iron rest is new and unique, as will be seen from the illustration, ears on the iron handles engaging in the side supports. The iron may be inverted on the top of the rest making an efficient electric stove on which water may be boiled and light cooking done. These irons are made in sizes ranging from four pounds to twenty pounds.

MILLAR DOMESTIC IRON ON STAND—AS USED IN IRONING.

The Millar immersion coil is a very handy device for heating small quantities of water almost immediately. It is small, compact and may easily be carried in the traveling bag. It is made in three sizes consuming respectively 250, 350 and 500 watts.

MILLAR ELECTRIC IMMERSION COIL FOR HEATING SMALL QUANTITIES OF LIQUID.

The electric toaster, also shown in one of the illustrations, is constructed on scientific principles and secures a maximum degree of efficiency at low cost. The Millar toaster is fitted with a removable tray and bread rest on which bread may be placed while the toaster is in operation. The toaster has a capacity for two slices. Francis Granger, Chicago, Ill., is the distributing agent for these devices.



MILLAR ELECTRIC TOASTER WITHOUT BREAD RACK.

A Switch for Severe Service.

The Detroit Fuse & Manufacturing Company, Detroit, Mich., has placed on the market a new type of "Detroit" switches known as the "Severe-Service Junction-Box Switch." In addition to being an ironclad fused switch, this device provides for the branching out of circuits in all directions and for the main lines passing entirely through the box and under the porcelain base.

The "Detroit Severe-Service" switch is a quick-make-and-break switch absolutely positive in its action, and controlled instantly from the outside of a cast-iron box. All working parts are of phosphor-bronze, making rust-proof design, and the switch is equipped with gaskets, giving a water-tight construction.

It can be installed out-doors or where directly exposed to water, steam, fumes, or any other extreme conditions. This switch is especially desirable for engine-house service and is being rapidly adopted by prominent railroads as part of their equipment.

DETROIT "SEVERE-SERVICE" SWITCH.

Stereo-Pyrometer.

This is an ingenious and handy little instrument which has recently been invented for ascertaining the temperature of muffles, furnaces, pottery kilns, steel furnaces, case-hardening furnaces, etc., and it can be used for any temperature from 550 to 2,000 degrees centigrade. It has been found specially useful in ascertaining the temperature of all kinds of metals, and can be used by workmen. It consists essentially of small glass cells containing dyes, the absorptive powers of which are so chosen that all light of whatever color emitted by a hot body at

a given temperature is absorbed. Each differently colored dye corresponds to a different temperature. The instrument is used like a spectroscope for direct observation only, and it cannot be used unless the hot body is visible, either directly or by reflection. The articles can be viewed through an observation hole located at any convenient part of the furnace. In half a minute or so after the instrument is applied to the eyes the articles seen through the dyes in the cells will be visible as a deep maroon or crimson patch, of the same shape as the observation hole, if their temperature is higher than that engraved on the cell caps. If one steady temperature has to be maintained, it is recommended to use an instrument with two pairs of cells, one for a temperature slightly higher than the other. The articles or the furnace under examination will be at the correct temperature when the sight-hole is visible through the cell for the lower temperature, and invisible through the one for the higher temperature. The instrument is made by W. and J. George, Limited, Great Charles Street, Birmingham, England.

An Electric Burglar Alarm.

An electric burglar alarm which was recently exhibited in England involves the principle of the Wheatstone bridge, which is thrown out of balance by any intruder. The tread of any person on the floor will, by changing the resistance in one of the arms of the bridge, light the lights, ring alarms or do anything else that is desired in the way of arousing the residents of the house where it is installed.

Despatch Electric Ovens.

It is generally conceded that to be successful the electric range or oven should embody at least the fundamental principle of the fireless cooker, that of heat storage. This characteristic seems to have been successfully incorporated in the electric ovens, illustrated herewith, which are being placed on the market by the Despatch Manufacturing Company, Minneapolis, Minn.

The standard ovens of this company are designed primarily as heat-storage plants, the retaining walls in the baking compartment being covered with heavy tile of a special composition which prevents external radiation. This feature of construction is well illustrated by the claims of the manufacturer that an oven, of a size sufficiently large to bake 100 loaves of bread at one time, consumes 16,000 watts for three hours to raise the temperature to the high baking point. The current is then turned off and the process of baking continues without further use of current. Several bakings can be accomplished with the initial heating and if the oven is used every day sufficient heat is stored to require current being used only one hour to bring the temperature to the baking point. The same principle applies to the smaller commercial ovens and also to the household size.

The heating element is, of course, an important feature of an electric oven. In the Despatch ovens a special wire known as "Grapptol" is employed and the success with which the ovens of this manufacture are meeting is a fair indication of the qualities of "Grapptol" wire. The wire used is a metal alloy especially drawn for these ovens and is claimed not to oxidize at a temperature equivalent to red heat, and not to become brittle with repeated heating and cooling. The wire after being received from the manufacturers is again specially treated in the laboratories of the Despatch Manufacturing Company before being installed in an oven.

In Fig. 1 is shown oven No. 100, which is especially designed for flour-mill laboratories and bakeries where accurate and uniform baking is desired. This oven is made of polished steel and angle-iron corner construction, and has two-inch solid heat-retaining walls of an asbestos composition. It is equipped with heat regulators, observation windows and two doors.

FIG. 1.—DESIGN NO. 100.

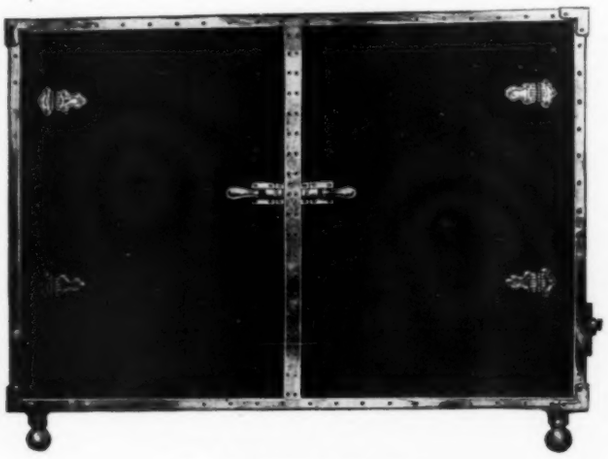


FIG. 2.—DESIGN NO. 275.

The oven shown in Fig. 2 is known as No. 275 and is designed for baking enamel, japan and lacquer, also arranged for annealing, roasting and vulcanizing. In construction it is similar to oven No. 100, but is built for temperatures up to 650 degrees Fahrenheit.

This company manufactures ovens for every conceivable purpose, as well as special ovens, according to individual specifications. All are built for either alternating or direct current at standard voltages.

Exports of copper for the week ending March 23 were 4,557 tons. The amount since the first of the month was 16,753, as against 11,442 last year.

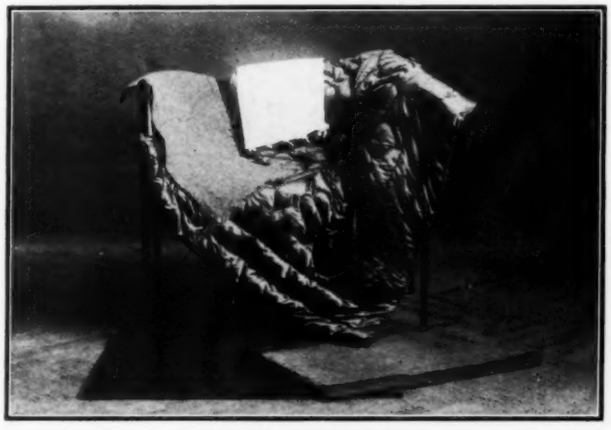
Herrgott Fabrics.

The problem of incorporating an electric heating wire directly into a woolen or other textile fabric appears to be very successfully solved by a French engineer, M. Herrgott. In this way he obtained many kinds of fabric which are very well adapted for domestic use, and other kinds can find employment in the industries. What he desired was to produce carpets, covers or knitted fabrics which have all the appearance of the ordinary but at the same time are heated by the electric wires which they contain. Such fabrics will add much to modern comfort and appear to be quite in the line of progress among the growing applications of electricity.

It might be thought that it was impossible to incorporate a metal heating wire directly into a woven fabric, but the inventor now succeeds in doing this without any danger of burning, by using a special method. As explained before the French Academy of Sciences, what characterizes this system is the fact that the heating wire is placed in the thread which goes to weave the fabric and such thread is at the same time heating and textile so that the usual appearance as well as the flexibility of the fabric is preserved. It is to be remarked that instead of using a few wires carried to a high heat, there are as many wires as threads; accordingly the wire is of great length and in consequence needs to be but very slightly heated in order to produce a given temperature. The threads are made of a core of wool around which is wound spirally a special flexible nickel wire. The nickel wire is, in fact, a flat braid made of many fine wires. After wrapping the nickel on the wool thread a covering of any suitable thread is braided on, wool, silk or cotton, as the case may be.

A flexible thread is thus obtained which can be woven on a loom or otherwise treated as an ordinary thread. The nickel wire is well protected and does not break as the strain is taken by the textile threads and not by the metal. Such fabric has a high electric resistance and can thus be put at once on a 50 or 100-volt circuit and holds a definite temperature. It might seem inadvisable to press the threads tightly together as in weaving, but the wire has only to heat a minute width of tissue and its temperature need not be high in order to give what heat is needed. The contrary would be true if but a few wires were used. The same applies to the voltage between wires, which is extremely low and not dangerous. Pure nickel is used as it does not oxidize, and as its resistance increases rapidly with temperature so that it becomes self-regulating.

Some of the applications of the new process are shown in the accompanying illustration.



HERRGOTT FABRICS.

ELECTRICALLY HEATED RUGS.

Standard Devices for Electrical Stage Effects.

Electricity is now so necessary for producing the stage effects satisfactory to modern audiences that the development of a complete line of devices for this purpose by the General Electric Company is of much interest not only to theater managers but also to the theater-going public.

Heretofore, the principal drawback to the installation of this class of apparatus has been the difficulty of combining the products of various manufacturers into a harmonious system, and, though some of the larger playhouses have been equipped with adequate and even elaborate installations of this character, the experience gained has served to emphasize the general demand for a complete standardized line having the uniformity and efficiency of the product of a large manufacturer.

The new line now being placed on the market by the General Electric Company is well calculated to meet this demand. It includes practically every electrical device required for producing any desired effect of light and sound, designed and constructed with special care to make them not only convenient and reliable, but also absolutely fireproof, as guaranteed by the approval of the entire line by the Underwriters' Laboratories.

A particularly noteworthy feature is the unusual consideration given the best interests of prospective customers by designing the stage plugs, spiders, floor pockets, etc., to fit the complementary parts of similar devices of other popular makes, thus practically eliminating the many difficulties usually encountered by those charged with the electrical equipment of route companies, and to whom interchangeable and portable stage plugging devices are an absolute necessity.

Special attention has been directed towards the development of lens lamps or spot lamps and flood lamps. They are of the hand-freed type, absolutely spark-proof and provided with solid aluminum lamp boxes, and interchangeable telescopic stands.

While the feature of interchangeability has received important consideration in the case of stage-plugging de-

vices, that of adaptability has been given much thought in the design of the dimmers. This class of apparatus without which it is practically impossible to obtain the fine gradations of light, shade and color, now recognized as essential to the proper rendering of the opera and drama, must be capable of being readily arranged to suit various requirements. They are, therefore, made in resistance units or plates, which may be used singly or in banks composed of several plates. These plates are provided with individual rheostat arms, which, in the bank form, are moved over the contact segments by means of levers working on a common rod or shaft. In the interlocking type of dimmers these levers can be simply and quickly locked to the rod, thus permitting the operation of the bank as a whole by means of a master lever.

Furthermore, special effort has been directed towards making the action of these dimmers perfectly noiseless, thereby preventing any intolerable interference with acts requiring absolute silence, while the liberal electrical design of the plates practically eliminates all possibility of burn-outs, which are invariably disastrous to scenic effects.

Dimmers for controlling any number of lamps can be readily obtained by specifying the number of lighting circuits, the number of lamps on each circuit, the type of lamps to be used and the supply voltage.

An important supplementary line of apparatus includes mercury-arc rectifiers for obtaining direct current from alternating-current service, and economy transformers for use with motion-picture machines operating on alternating-current circuits.

The entire list of supplies indicates that nothing needing electrical service inside or outside the theater has been overlooked. While effective lens lamps, flood lamps, color wheels, stage strips, stage-plugging devices, dimmers, switchboards, etc., enhance the stage manager's resources for producing realistic and ultra-realistic stage effects, there are luminous radiators for heating the box offices, fan motors and exhaust fans for cooling and ventilating, stage flue control devices, monogram announcers, arc and incandescent lamps of special design for lighting the auditorium, entrances, foyers and exits, and brilliant flame arc lamps for illuminating the exterior of the theater.

New Method of Motor Control.

The acceleration of electric motors has in the past been accomplished by different starting devices varying from a simple hand-operated type to the magnetic-switch motor starter. A magnetic-switch starter, by the proper operation of magnetically operated switches, cuts out, step by step, the starting resistance. Such operation is automatic and in a properly designed apparatus affords thorough protection to the motor and to driven machinery. A magnetic-switch motor starter is expensive and complicated, but despite these handicaps it has been widely used in connection with large motors and for automatic control, because of its obvious advantages.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has discovered and developed commercially a magnetic switch radically new in principle and operation. This switch, which is known as the type A switch, has an operating coil which is connected in series with the motor to be started, this coil being composed of a few turns of heavy wire of fireproof insulation. The switch has the remarkable characteristic of inherently and automatically closing its contacts only when the motor current is below a predetermined value. It is in other words a combined magnetic switch and current-limiting relay. If the motor current flowing through this switch exceeds a predetermined value, this switch will lock out and will not close until the current has been reduced by the speeding up of the motor. A train of these switches cutting out starting resistance step by step provides a method of motor acceleration which is absolutely automatic and protective, and it accomplishes this with apparatus so simple that its expense will not prohibit its application for the starting of any electric motor.

The front and side views of such a magnetic switch are shown in Fig. 2. The operating coil is inclosed and protected by a cylindrical iron shell mounted on a slate panel; at the top are two copper-laminated brushes which, when the switch operates, are short-circuited, thereby cutting out a section of resistance. At the bottom of the coil shell a movable plug is provided for adusting the amount to which current must fall before the switch operates; screwing in this plug will increase the lock-out value, and, of course, screwing out the plug will reduce the value of the lock-out current.

Fig. 1 shows the operating characteristics of the switch in question. Here

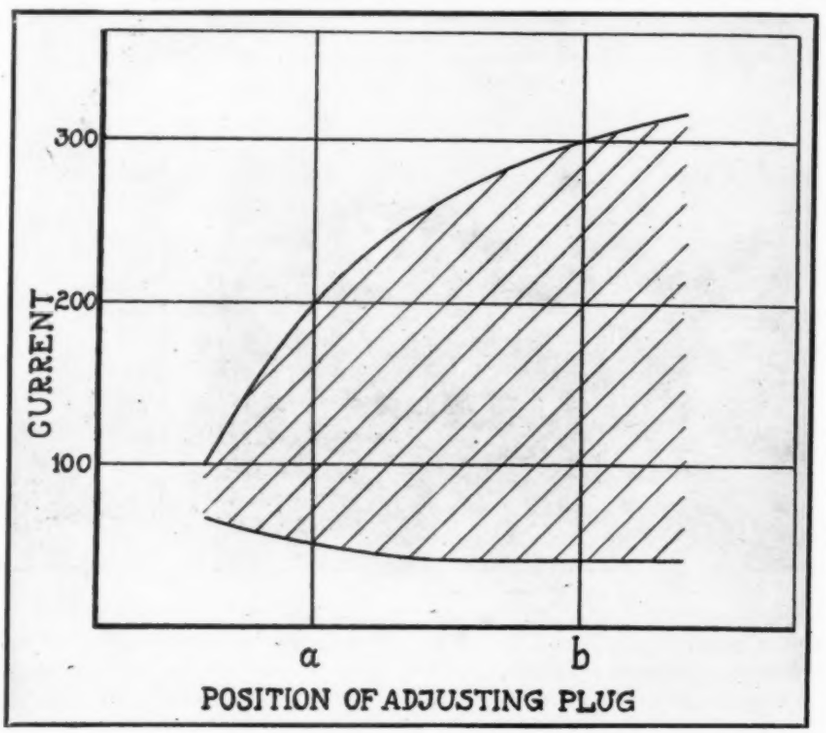


FIG. 1.—OPERATING CHARACTERISTICS OF TYPE A MAGNETIC SWITCH.

vertical distances represent current flowing through the operating coil; horizontal distances, positions of the adjusting plug. The shaded area indicates the operating limits of the switch. For example, if the plug be at position "a," the switch will lock out at any current above 200 amperes, but will definitely close as soon as the current falls to 200 amperes. Similarly, with the plug at position "b," the switch will lock out at any current

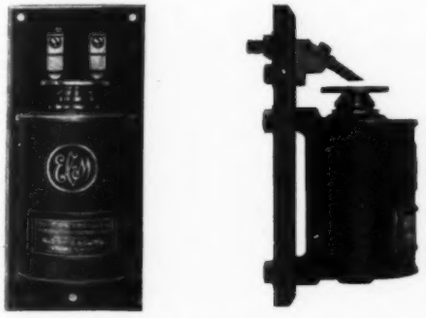


FIG. 2.—TYPE A MAGNETIC SWITCH.

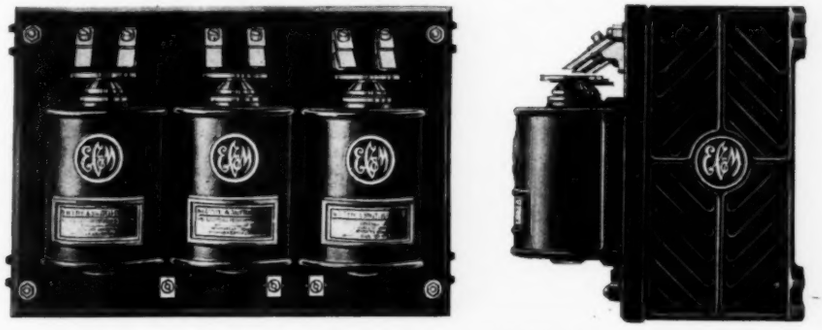


FIG. 3.—TRAIN OF TYPE A SWITCHES.

value above 300 amperes, but will operate when the current falls to 300 amperes. The bottom of the shaded area indicates the minimum current at which the switch is operative, although, of course, after the switch has once closed it will remain closed until the current has dropped to practically zero.

It will be apparent from what has been said descriptive of this switch that its use is peculiarly suitable for motor starters. As a matter of fact the Electric Controller & Manufacturing Company has developed a very complete line of motor starters embodying the use of the type A switch, these starters having been designated type E. C. & M. automatic motor starters

They have been standardized for 110, 220 and 550 volts, direct current, and over a wide range of horsepowers. In order to make them as universally applicable as possible, the starters have been laid out in six different forms and, in addition, with various numbers of the accelerating switches. The simplest form consists merely of a train of type A switches suitably mounted in connection with resistance and the front and side views of such a starter, are illustrated in Fig. 3. This starter is intended to be used in connection with a knife switch exterior to the starter. If it is desired to incorporate the knife switch in the starting panel this requirement can be met by the form illustrated in Fig. 4. Where push-button or automatic control is desired, and also preferably for large motors, a shunt-wound magnetically operated switch is also incorporated; the appearance of this switch being shown in Fig. 5. The starter, including the type S magnetic switch shown in Fig. 5, can be also equipped with an overload giving complete circuit-breaker features, and either of these modifications can be furnished with or without knife switches.

A complete line of accessories has also been developed, such, for instance, as would be required for automatic pressure regulation, maintenance of water level in water tanks, etc. The number of accelerating points which any particular starter will develop is one more than the number of accelerating switches used. For small motors where the load to be accelerated is light, one or two type A switches will be ample. On the other hand, for large motors, and particularly motors which have to accelerate heavy inertia loads, five or six type A switches should be selected.

Even the simplest form of this company's automatic motor starter inherently provides no-voltage protection, for if the voltage fails, all of the switches at once drop out, inserting all of the starting resistance in series with the motor, and upon the return of voltage the motor is automatically accelerated in the normal method. With such a starter it is merely necessary to close the knife switch to start the motor and to open the knife switch to stop the motor. The acceleration of the motor is entirely automatic and will be accomplished in the shortest safe time.

FIG. 4.—TYPE A SWITCHES MOUNTED WITH KNIFE SWITCH.

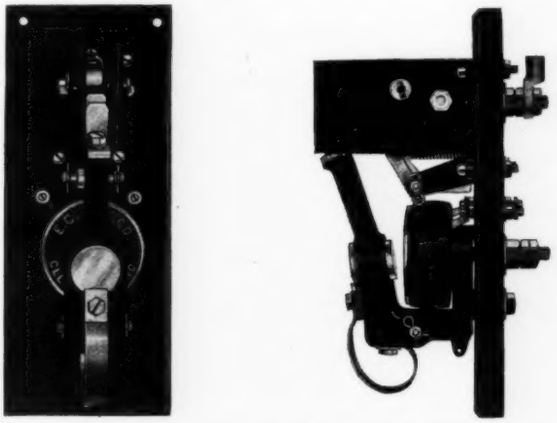


FIG. 5.—MAGNETICALLY OPERATED SWITCH USED WITH TYPE A SWITCHES.

An Improved Balanced Automatic Governor.

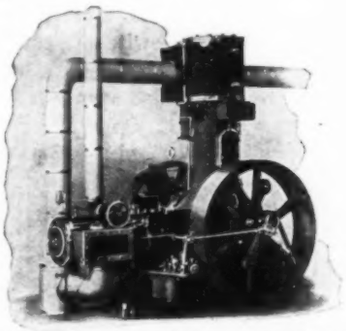
In the early days, when the steam engine was generally used for driving flour mills, pumping water, etc., and the matter of constant speed was not of much importance, the old fly-ball or pendulum governor developed by Watt was all that was required. However when the steam engine came to be used for driving generators, and especially for lighting service, it was soon evident that a variation in speed of even 2 or 3 per cent produced an annoying flickering of the lamps and that a more sensitive governor was necessary. As the fly-ball type had many inherent disadvantages, the automatic shaft governor was developed and used on electric lighting engines, especially the high-speed type used for lighting service.

One of the disadvantages of the pendulum governor is that as these governors usually actuate a throttle valve in the steam line, there is a certain time lag between the time the steam leaves the throttle and when it reaches the piston. The drop in pressure caused by the throttle valve also reduces the effective energy in the steam which the engine could convert into work.

The shaft governor is open to neither of these objections, for it works directly on the steam valve, so that there is no time lost between the regulation of the steam supply and its application to the piston.

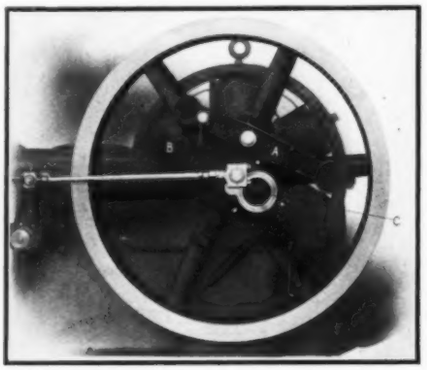
These automatic governors consist essentially of a weight within the flywheel supported eccentrically to the shaft and connected to the valve rod by suitable links. Centrifugal force is opposed by a spring which draws the weight back to its normal position when the engine is at rest. However, one serious objection to most of these governors is that no allowance is made for the action of gravity upon the governing weight. That is, when the weight is over the shaft, gravity tends to bring it nearer the center, and when it is below the shaft, gravity tends to draw it further away from the center; thus there is a periodic shifting twice in every revolution which varies the setting of the valve entirely independent of the speed of the engine.

In the accompanying illustration is shown the governor which is used on all types of the American engine, but was developed especially for use on the angle-compound type. This governor was designed with the idea of perfecting a governor which would not be influenced by gravity and which would regulate the valve so that a constant speed would be maintained, no matter what the variations in load upon the engine.



ENGINE WITH AUTOMATIC GOVERNOR.

The American balanced governor consists of the arm A, pivoted at some convenient point and having a weight at the right-hand end which is acted upon by the centrifugal force. Connected to A by means of a link is another lever B, which carries the pin that determines the throw of the steam valve. B is free to move about the center C, and change the eccentricity of the valve pin by an amount depending upon the position assumed by A,



DETAIL OF BALANCED AUTOMATIC GOVERNOR.

which in turn depends upon the speed of the engine.

The arm B is so designed that its center of gravity coincides with the center of the shaft; therefore, the speed of the engine does not tend to move it one way or the other, and in order to counteract the gravity effects mentioned above, the arms A and B are so proportioned that their centers of gravity always balance each other, no matter what position the engine shaft is in. The engine can be stopped in any position and gravity will not tend to shift the eccentric pin; whereas, had the arm B been omitted, the position of the eccentric pin, upon the stopping of the engine, would depend upon whether the weight on A were above or below the center of the shaft.

Another improvement is the use of two braced springs. These springs are so braced that they resist gravity and centrifugal force, and are not subject to the swaying and bellying met with in single springs, especially when operating at high speed. These springs also provide means for making slight speed adjustments. If the speed be unsteady under load, a slacking of the radial spring and a tightening of the other one reduces the variation, while the reverse operation increases it. To increase the speed two or three revolutions the nut at the junction of the two springs can be tightened a little. The possible speed change by this method is not very great. However, it is of great importance where several machines are to operate alternators running in parallel. To make a greater change in speed of the engine, weights should be taken on or added to the right hand end of the arm A.

All of the mechanical details of this spring have been carefully worked out, such as the use of a knife edge where the link connecting the spring to the arm A is attached to the latter. Two stops on the arm A prevent the governor from shifting beyond certain limits.

It should be noted that governors on the angle-compound engine are not subjected to the racking and vibration that is usually met on single engines for the reason that the angle-compound engine is so balanced that practically no vibrations are set up. Thus there is nothing to loosen the adjusting screws on the governor.

This type of balanced shaft governor is now supplied on all engines built by the American Engine Company, of Bound Brook, N. J.

Consul Albert Halstead notes from statistics issued by the British Local Government Board for the year 1909-1910 that for the twenty years prior thereto $128,405,590 was borrowed by British municipalities and rural district bodies to construct electric lighting plants. The sum borrowed by Birmingham in 1909 was $569,380.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Thel Public Service Commission, Second District, conducted a hearing on March 23 on the various complaints as to the street car service of the United Traction Company of Albany. The complaints under consideration were those of the Albany Common Council, Augustus S. Downing, Charles S. May and the Pine Hills Association, and relate particularly to the crowded conditions of the cars during the rush hours on the Pine Hills and West Albany lines.

It has been the contention of the Commission's experts that the only remedy was in putting in operation larger cars to replace the old box cars seating twenty-two persons, a number of which are used on both lines. At the outset the company contended that it was impracticable and unsafe to operate larger cars on the State Street hill. This contention was proven not to be a sound one and then the company set up a defense that if it were required to operate large cars the cost would be beyond the resources of the company and not warranted by the traffic. The experts of the Commission showed that the operation could be had for very much less than the figures submitted by the company.

A complaint has been received by the Public Service Commission, Second District, from the president and Board of Trustees of the village of Ossining, relative to the price charged for electric lighting in that village by the Northern Westchester Lighting Company. The complaint has been served upon the company and an answer requested within ten days.

The investigation of the Public Service Commission, First District, is already under way and an itemized monthly statement of all expenditures made by the Commission since its organization has been asked for, together with a list of all its employees, with a statement of their salaries and duties.

It is intended to investigate carefully each Bureau of the Commission, with the idea of finding out the work undertaken, the work actually accomplished and the cost thereof, and to get in personal touch with the character of the work of each Bureau and the men in charge thereof.

Public hearings will be held at the Engineering Society's Building, No. 29 West Thirty-ninth Street, in the City of New York, commencing on April 4, at 10 a. m.

LIGHTING AND POWER.

(Special Correspondence.)

REDFIELD, IOWA.—The installation of an electric light plant is being agitated. C.

LAVINA, MONT.—B. F. Fullmer, of Lewiston, Mont., will install an electric light plant here. P.

KEOKUK, IOWA.—The Water Power Company has begun the construction of an electric light plant. P.

EXCELSIOR, MINN.—C. E. Arndt of Belle Plaine has petitioned the council for a franchise for an electric light plant. C.

SEARS, ILL.—The Peoples' Power Company has asked the village board for an extension of its franchise rights. Z.

SHELBY, MONT.—A vote will be taken at the April election on the installation of an electric light plant at an estimated cost of $35,000. C.

RIDGEFIELD, WASH.—M. Schuler, of Minneapolis, Minn., is considering installing an electric lighting plant here within a few months. A.

WEBSTER CITY, IOWA.—Contract for the erection of the new municipal electric light and power plant was awarded to C. E. Atkinson for $9,897. Z.

WILLIAMSTON, N. C.—Work on the new local electric lighting plant is being started and the system is expected to be ready for use about May 1. L.

LOGANSPORT, IND.—Bids were recently opened for the new boilers, stokers, heaters, piping, etc., of the new electric light plant which is to be erected.

BARABOO, WIS.—Chamberlain & Howell, engineers, Chicago, are completing plans for a new lighting plant to be installed by the Baraboo Lighting Company. C.

SHARON, WIS.—The question of bonding the village for $7,000 for the installation of an electric light plant will be voted upon at the spring election. Z.

KERRVILLE, TEX.—The streets of Kerrville will soon be lighted with electricity. The contract has been let to the Kerrville Electric Light & Power Company.

LAUREL, MISS.—The Laurel Light, Heat & Power Company has been incorporated with a capital of $10,000. The incorporators are J. T. Pullen and R. T. Young.

PENDLETON, IOWA.—The town will soon have an electric light plant. Bonds issued for its construction have been purchased by the Pendleton Banking Company.

MORAN, IOWA.—A special election has been called for April 18 to vote upon the proposition to expend $18,000 for a municipal electric light and waterworks plant. Z.

MINNEAPOLIS, MINN.—The Puffer-Hubbard Manufacturing Company has let the contract for motor equipment to the Westinghouse Electric & Manufacturing Company. C.

MASON, TEX.—The Mason Ice & Power Company has been incorporated with a capital of $14,000. The incorporators are B. J. Jordan, D. F. Lehmberg and F. C. Beyer.

EDMONDSON, ARK.—The Edmondson Electric Plant and Manufacturing Company, which will get out lumber and conduct an electric plant, has been incorporated with a capital of $50,000.

ELKHART, IND.—The Industrial Association has filed a petition with the Board of Works asking that park post lights be placed on Main Street from Jackson Street to Tyler Avenue. Z.

SPOKANE, WASH.—Walter Bryant of the town of Orient will develop hydroelectric power at Boulder Falls, three miles from that place, and will put in a distributing system to supply light and power for Orient. A.

DOTHAN, ALA.—The matter of the erection of a new $90,000 light plant will be pushed as much as possible, and it is thought that construction work may begin within a few weeks. The present plant is valued at $30,000.

FAIRVIEW, S. D.—The Fairview Milling Company has let the contract to the Missouri Valley Engineering Company, to prepare plans for a hydroelectric light and power plant at the Big Sioux River, estimated to cost $50,000. C.

LAKEVIEW, N. C.—A charter has been granted by the State to the Electric Light & Power Company of Lakeview, Moore County, N. C., with $25,000 capital. J. B. Eastwood, of Lakeview, is an incorporator of the new concern. L.

SHOALS, IND.—The Southern Indiana Power Company and the Shoals Power Company have consolidated and will build a power dam in White River at this place. The object is to generate electricity for light, heat and power purposes. S.

ESCONDIDO, CAL.—The Escondido Utilities Company has planned to install a new system of electric lighting here. The present system is to be remodelled and it is planned to have forty-four additional lights in the street lighting system. A.

NEW HAVEN, CONN.—Announcement has been made that the Yale Corporation will soon start an electric light plant of its own, at an estimated cost of $100,000. The electrical plant will probably be operated in combination with the heating department.

FARMINGTON, ILL.—The Farmington Light & Power Company has been incorporated with capital stock of $30,000 to deal in electricity and other forms of power. The incorporators are Theo. Bass, M. M. Anderson, W. H. E. Worden and A. L. Thompson. Z.

VINTON, IOWA.—About $1,200 has been collected by Messrs. Hayward and Ray of the citizens' committee to secure funds for the installation of ornamental electric lights in the business part of town. Eight lamps to the block will be placed in the main streets. Z.

SAN FRANCISCO., CAL.—The Great Western Power Company's negotiations for the purchase of the City Electric Company's plant are reported to be making headway. The Great Western Power interests have agreed, it is claimed, to pay $150,000 for a ninety-day option.

BAKER CITY, ORE.—The city engineer has been instructed to prepare estimates of the cost of constructing a municipal power house on the city's site on Elk Creek. Estimates will also be secured for the construction of an additional storage reservoir to hold 3,000,000 gallons. A.

OKLAHOMA CITY, OKLA.—The Monticello Company, organized for the purpose of dealing in real estate and furnishing electric and water power, has been chartered with a capital stock of $100,000, with headquarters at Muskogee. Former-governor Haskell is promoting the project.

MARTINEZ, CAL.—The Bay Point Light & Water Company has been incorporated here to supply light and water to the town of Bay Point. The capital stock of the company is $25,000, the incorporators being J. McKee, A. W. Richards, J. F. Cumberland, B. C. Stratton and S. Brubaker. A.

GARDNER, MASS.—The Gardner Electric Light Company has issued $85,000 in preferred stock and $20,000 in common stock in order to make improvements and extensions.

PORTERVILLE, CAL.—The representatives of the Tulare County Power Company are soliciting contracts to supply farmers in this locality with electric power by the first of next January. It is given out that the company's power transmission lines will be extended to connect this place with Visalia, Tulare, Exeter, Lindsay and Strathmore. A.

BAKERSFIELD, CAL.—A. G. Wishon, general manager of the San Joaquin Light & Power Company, announces that the company will at once add 6,600 horsepower to the present capacity of the new steam generating plant recently completed in this city, bringing the total capacity of the plant to 11,600 horsepower. The cost of the improvements will be about $250,000.

KEOKUK, IOWA.—The firm of Stone & Webster of Boston, which is financing the building of the mile-wide dam across the Mississippi River here, has entered into negotiations with the Keokuk & Western Illinois Electric Company for the purchase of public utilities in Keokuk, including electric light, gas and the street railway. Sargent & Lundy of Chicago control these interests. Z.

ATLANTIC, IOWA.—The following bids were received for the installation of a light and power plant: The Joseph H. Bortlanger Company, Omaha, Neb., $49,000; Fogg & Ryan, Sioux City, $66,800; Des Moines Bridge & Iron Works, $57,000; Bailey & Marsh, Minneapolis, $51,278; and Faulhenman Electrical Construction Company, Chicago, $67,196. The contract was let to Joseph H. Bortlanger Company for $43,000. C.

KENNETT, CAL.—Power lines of the Sacramento Valley Power Company will be extended into Kennett within the next few months. This work will place the company on a competitive basis with the Northern California Power Company, which supplies electric light and power here and the adjoining mines. The cost of extending the power line from Redding to Kennett is estimated at about $50,000.

DILLON, S. C.—A new electric light plant is to be built here under the direction of the Electric Light Commission which was recently appointed. Bonds were voted here last summer to the amount of $15,000 for this purpose; the present property is valued at about $7,000, giving the commission about $22,000 to put in the new plant. The commission is composed of A. J. C. Cottingham, E. T. Elliott and M. A. Stubbs. The new plant will be in operation in a short time.

HAMILTON, O.—A deal has been completed for the erection of a $500,000 hydroelectric power plant to be erected this summer at Woodsdale. The company will wholesale electric power and claim they can furnish the city of Hamilton with electricity at a price less than the city coal bills. The company was incorporated at Columbus as the Miami Power Company by Messrs. H. L. Hanley and J. W. Durfue, of Chicago; W. D. James, of Detroit, Mich., and William Bergen and John Reif, of Overpeck, O.

ST. JOHN, N. B.—The formation of a company with a capital stock of $1,500,000 to harness the Lepreaux River and generate electric power for transmission to St. John and other communities was the project set forth in the bill introduced in the Legislature for the incorporation of the New Brunswick Hydro-Electric Power Company. The incorporators are Charles H. Easson, manager of the Bank of Nova Scotia in this city; Walter E. Foster and Percy W. Thomson, of St. John, and Herbert H. Beck of Toronto.

UNIONTOWN, PA.—Applications have been made for charters for the Upper Tyrone Electric Company, of Upper Tyrone township, the Lower Tyrone Electric Company, of Lower Tyrone township, and the Redstone Electric Company, of Redstone township. The three incorporators named in each application are E. M. Balsinger, A. E. DuBois and C. W. Scheck. The object of each company is the manufacture and supply of light, heat and power to both private individuals and corporations within their respective districts.

SALISBURY, N. C.—A $1,000,000 company has just been organized in this city for the purpose of engaging in the business of hydroelectric power development. The chief promoter is Dr. J. J. Mott, of Statesville, N. C., who for some time has been buying in waterpower sites along rivers in Virginia, and turning the same over to those actively interested in the work. It is stated that over 100,000 horsepower has been procured in this manner. The name of the concern is the Virginia Power Company, and the principal developments will be on New River, in Virginia. L.

PULASKI, VA.—Plans for the development of a 40,000-horsepower hydroelectric plant near this city are now on foot, and a tract of seventy-five acres embracing the site of the plant on New River, has been purchased for $10,000 through O. L. Stearns, of Salem, Va. The syndicate which is behind the development has, it is given out, agreed to purchase through Mr. Stearns, as agent, the electric lighting plant located in Pulaski for a $25,000 consideration, and the City Council has called for bids for a new franchise for lighting the city, the same having already been opened. L.

ELECTRIC RAILWAYS.

(Special Correspondence.)

EDWARDSVILLE, ILL.—The Richards Brick Company is building an electric railway 1,700 feet long at its plant which will be supplied with power by the Illinois Traction System. Z.

MONTREAL, CAN.—The Winnipeg Electric Railway has offered to sell out to the city of Winnipeg on a basis of $250 a share. The city is applying to the legislature for power to purchase the railway.

WAYZATA, MINN.—The survey for the construction of the electric line for the Electric Short Line has been commenced. It is expected that the construction of the line will be rushed so as to have cars running by June 15, 1911. C.

WABASH, IND.—J. A. Barry has revived the project to build an interurban line from Ft. Wayne to Warsaw and has gone East on business connected with the financing of the enterprise. Mr. Barry said he had assurances of sufficient aid to build the road. S.

SOUTH BEND, IND.—Extensive improvements on the lines of the Chicago, South Bend & Northern Indiana Railway Company will be begun in a few weeks, according to the statement of General Manager Frank H. Cutshall. Several lines are to be double tracked.

CLEVELAND, O.—Announcement has been made that an electric road will be built from Alliance, a distance of twenty miles. At Ravenna connection will be made with the lines of the Northern Ohio Traction & Light Company, which will provide for the direct connection of Alliance with Cleveland.

FREMONT, OHIO.—The Fremont & Fostoria Electric, a new line now building and which will be in operation within a few months, has taken over the Fremont City Railway Company, thus gaining direct entrance into the heart of ths city, and securing good connection with the Lake Shore Electric here. H.

BALTIMORE, MD.—The Washington, Baltimore & Annapolis Electric Railway has been sold under a decree of foreclosure, issued by the United States court, to satisfy the first mortgage for $3,000,000 and the second mortgage for $1,000,000. The property was bid in by the reorganization committee for $2,501,000.

TORONTO, ONT.—Negotiations are being conducted by the Canadian Northern Railway and the British Columbia Steel Corporation, capitalized at $10,000,000, for the location of its big steel plant at Port Mann. Water power will be generated on a large scale and a great deal of the smelting will be carried on by electricity.

IRONDALE, MO.—James P. Ward of this city has plans under way for the construction of an interurban electric railway which will be operated with power generated at hydroelectric plants. The line will begin at St. Louis and extend through the Bellview Valley in Washington County, Mo., with branches to the south, southeast and southwest.

DANBURY, CONN.—The controlling interest in the Danbury & Bethel Street Railway Company, operating in this city and between here and Bethel, has been transferred to Saunders & Jones, bond brokers of New York, associated with whom is A. William Sperry of New Haven, head of the engineering firm which built the Shore Line trolley road and planned the Danbury & Bridgeport, which is to be constructed this year.

ST. PAUL, MINN.—The Village Council has granted transit rights to the St. Paul Railway Promotion Company to put a line along Pleasant Avenue. The company contemplates building a line to Lake City and forty-two miles of the right-of-way have been secured. It is announced by one of the directors that the company intends to build a spur line connecting with the Twin City Rapid Transit Company's lines at Inver Grove. Z.

SAN BENITO, TEXAS.—The system of interurban railway that is being constructed in the lower Rio Grande Valley by S. A. Robertson of San Benito and associates will be extended from this place to Mission, about seventy-five miles. The route of the proposed extension is through a number of large irrigated plantations. Several miles of the new system have already been constructed from San Benito to points in the lower part of the valley D.

CHARLOTTE, N. C.—The contract for the first link in the big interurban line to be constructed by the Southern Power Company has been let to Stewart & Jones, of Baltimore. The line will run from Charlotte to King's Mountain, a distance of thirty-five miles, and the contract calls for its completion in 120 working days. The bid was $400,000. The contract for the next link, from King's Mountain to Greenville and Greenwood, S. C., via Anderson, a distance of sixty miles, will be let soon.

INDIANAPOLIS, IND.—The Beech Grove Interurban traction line was opened for service March 20. The line extends from Indianapolis to Beech Grove, a distance of eight miles. The company will operate three cars. The Big Four Shops, employing 1,200 men, are located at Beech Grove and the suburban train will be abandoned since the interurban no longer makes it a necessity. The completion of the Beech Grove line makes the twelfth interurban road centering in Indianapolis. John Wocher is president of the company, and C. S. Schmidt, secretary. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

TIMBER LAKE, S. D.—F. E. Sexton will construct a telephone line to Isabel and other points. C.

MOBRIDGE, S. D.—The Missouri Valley Telephone Company has asked the city for a franchise. P.

TEKONSHA, MICH.—The telephone company here is planning to extend its lines in the spring.

RANDOLPH, NEB.—The Meridan Telephone Company has been incorporated with a capital stock of $2,000. P.

NORTH YAKIMA, WASH.—The North Moxee Telephone Company has been incorporated with a capital stock of $25,000. P.

LAFOLETTE, TENN.—Work has been started on the construction of the lines of the East Tennessee Telephone Company here.

NEWBURG, N. D.—The Farmers' Telephone Company has decided to erect a telephone office and string long distance wires to Landa. C.

BELT, MONT.—The Belt to Tiger Butte Telephone Company has been incorporated by Hans and Samuel Johnson, Chas. F. Anderson and others. C.

HOUSTON, TEX.—The contract has been granted for the construction of a $35,000 building in which the offices of the Automatic Telephone Company are to be located.

ELKO, NEV.—F. H. Winter, A. Z. McCloy, S. S. Andrews and E. C. Murray, all of Jarbridge, in this county, have applied for a telephone franchise to extend from Jarbridge to Deeth.

WESTPOINT, IND.—The Westpoint Co-operative Telephone Company has increased its capital $6,000 for the purpose of making improvements, extensions and installing new equipments. S.

PULASKI, ILL.—The Pulaski Telephone Company has been incorporated with capital stock of $2,500 to conduct a telephone exchange. The incorporators are W. A. Lackey, J. B. Kennedy and James N. Palmer. Z.

SAC CITY, IOWA.—The Farmers Mutual Telephone Company has incorporated with a capital of $5,000. The incorporators are W. W. Henning, John Hechtner, John G. Brill, G. J. Hein and A. F. Mathews.

AURORA, IND.—The Holman Mutual Telephone Company has incorporated to build, equip and operate a telephone system in Holman and Dearborn County. I. M. Cross is president and J. B. Todd secretary. S.

WAUSAU, WIS.—The Wausau Telephone Company has let the contract to John Anderes & Son for the erection of a three-story reinforced concrete building. The building will be completed by January 1, 1912. C.

HUNTSVILLE, ALA.—The Southern Bell Telephone Company has just finished extensive improvements in the plant here, including the installation of a large number of new cable lines. Between $15,000 and $20,000 has been expended.

DENISON, TEX.—The Missouri, Kansas & Texas Railroad Company will construct telephone lines from Denison south to Hillsboro via Fort Worth, from Denison to Hillsboro via Dallas, and from Hillsboro to Smithville, also along the Dallas and Denton branch.

ELECTRICAL SECURITIES.

The past week has been one of the dullest in the history of the New York stock market, and the cause seems to lie largely in the fact that investors hesitate on account of the yet unsettled Standard Oil and American Tobacco cases. Money is easy and while the copper market is extremely slow, both iron and steel are showing up very well.

The Rio de Janeiro Tramway, Light & Power Company has sold $3,000,000 fifty-year five-per-cent bonds.

W. E. R. Smith & Company are offering Gas & Electric Company of Bergen County guaranteed stock, Public Service Corporation of New Jersey guarantor.

At the annual meeting the American Light & Traction Company James H. Wilson, of Wilmington, Del., was elected a director to succeed Henry L. Doherty, resigned.

Metropolitan Street Railway sold last week two issues of five per cent receivers' certificates of $3,500,000 and $2,750,000 to take up similar issues which matured March 15.

Chicago & Milwaukee Electric net earnings for 1910, as reported by receivers to United States Circuit Court, were $144,449. Report for January this year showed a deficit of $3,613.

All of the $1,000,000 first-mortgage five-per-cent bonds of the Cleveland Electric Illuminating Company, recently offered by Spencer Trask & Company, have been sold.

The Chicago Railways Company reports earnings for the three weeks ending March 21, 1911, of $907,631, an increase of $192,185.

The best January and February in the history of the Kings County Electric Light & Power Company characterizes the first two months of the current calendar year. The year 1910 and the first two months thereof also made a new high record up to that time. From January 1 to February 28 gross earnings have increased $107,445, or 14.67 per cent. In the same period, surplus applicable to dividends increased $19,320, or 9.41 per cent.

President Insull, of the Commonwealth Edison, says that the stock to be issued next November will probably be ten or fifteen per cent of present $33,000,000 issued capital. He says regarding Commonwealth Edison dividend that earnings fully justify increase which was felt desirable in view of the fact that stock issues must provide for so large a proportion (approximately fifty per cent) of necessary money for increase of company's permanent plant to meet growth and development of its business. Large amounts have to be obtained by sales of new stock and the company believes that higher rate of dividend than six per cent is needed to make future issues sufficiently attractive.

DIVIDENDS.

American Gas & Electric Company; regular quarterly dividend of one and one-half per cent on the common stock, payable April 1 to stock of record March 23. Books close March 23 and reopen April 3. Regular quarterly dividend of one and one-half per cent on the preferred stock was also declared, payable May 1 to stock of record April 20. Books close April 20 and reopen May 2.

American Power & Light Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable April 3 to stock of record March 25.

Bell Telephone Company of Missouri; dividend of one per cent, payable April 1. For several years the company paid eight per cent annually. The December, 1910, dividend was passed, however, making six per cent paid in 1910.

Commonwealth Edison Company; quarterly dividend of one-and-three-fourths per cent, payable May 1 to stock record April 15, an increase of one-fourth of one per cent quarterly.

Electric Storage Battery Company; one per cent on both common and preferred stocks, payable April 1.

Honolulu Rapid Transit & Land Company; quarterly dividend of one-and-one-half per cent on its common stock, payable March 31 to stockholders of record March 27. The common stock dividend was four per cent from 1908 to 1910, inclusive, three per cent in 1907, three-and-one-fourth per cent in 1906, and four per cent in 1904 and 1905.

Illinois Traction; preferred quarterly dividend of one-and-one-half per cent, payable April 1.

Kansas Gas & Electric Company; quarterly dividend of one-and-three-fourths per cent on the preferred stock, payable April 1 to stock of record March 27.

Shawinigan Water & Power Company; quarterly dividend of one-and-one-quarter per cent.

United Light & Railways Company; first preferred dividend of one-and-one-half per cent, and second preferred of three-quarters per cent, payable April 1.

West Penn Traction Company; quarterly dividend of one-and-one-half percent on the preferred stock, payable April 15 to stock of record April 7.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.	Mar. 27.	Mar. 20.
Allis-Chalmers common	7⅞	7⅞
Allis-Chalmers preferred	31	31
Amalgamated Copper	63	63⅞
American Tel. & Cable	*80¾	*80¾
American Tel. & Tel.	146⅝	146
Brooklyn Rapid Transit	78¼	77½
General Electric	147¾	148
Interborough-Metropolitan common	18⅝	19⅝
Interborough-Metropolitan preferred	53	54¾
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common.	90½	90½
Mackay Companies (Postal Telegraph and Cables) preferred.	75⅞	75
Manhattan Elevated	135¼	136
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	52⅝	52½
U. S. Steel common	78¼	78
U. S. Steel preferred	119	118½
Western Union	72¼	72
Westinghouse common	66	66
Westinghouse preferred	120½	120½

*Last price quoted.

BOSTON.	Mar. 27.	Mar. 20.
American Tel. & Tel.	146⅝	146
Edison Elec. Illuminating	284	289
General Electric	147¾	148½
Massachusetts Electric common	17½	17¾
Massachusetts Electric preferred	87	87
New England Telephone	144	142
Western Tel. & Tel. common	20⅛	20
Western Tel. & Tel. preferred	92½	93

PHILADELPHIA.	Mar. 27.	Mar. 20.
American Railways	44	44
Electric Company of America	11⅞	12
Electric Storage Battery common (ex dividend)	54	54
Electric Storage Battery preferred	54	54
Philadelphia Electric	16⅛	16⅛
Philadelphia Rapid Transit	19¾	19½
Philadelphia Traction	84¼	84
Union Traction	47¾	47¼

CHICAGO.	Mar. 27.	Mar. 20.
Chicago Railways, Series 1	89½	90
Chicago Railways, Series 2	23½	24
Chicago Subway	4½	4⅞
Chicago Telephone	122	120½
Commonwealth Edison	128	126¾
Metropolitan Elevated common	23¼	21
Metropolitan Elevated preferred	68½	69

PERSONAL MENTION.

F. D. MASTERSON, special representative of the Condit Electric Manufacturing Company of Boston, spent a few days in Chicago on his return from an extended trip to the coast.

J. M. PORTWOOD has resigned his position as manager for the Macon County Telephone Company, at Decatur, Ill., and will remove to the Northwest to engage in other business.

S. P. EVILSIZOR, who has been manager for the North Shore Electric Company, at Libertyville, Ill., has been appointed manager for the Paxton Electric Company, at Paxton, Ill.

A. L. CASH, of Eau Claire, Wis., has been appointed manager for the Wisconsin Telephone Company, at Beloit, Wis., to succeed J. H. Quinlan, who will be transferred to a larger city.

GEORGE A. McKINLOCK, president of the Central Electric Company, returned on Monday to Chicago having enjoyed a tour through Europe with Mrs. McKinlock for several months during the winter.

CHARLES P. STEINMETZ will address the April meeting of the Washington section of the American Institute of Electrical Engineers on April 11 at the Cosmos Club Hall. The subject of Dr. Steinmetz's lecture has not yet been announced.

W. E. SCHAPHORST, of the mechanical engineering department of the New Mexico College of Mechanical Arts, has resigned his position there to become a technical writer on the staff of A. Eugene Michel, advertising engineer, of New York City.

G. L. SAUNDERS has resigned his position as manager for the Interior Telephone Company, at Grinnell, Iowa, to accept a place with the Electrical Contract Company, of Grinnell. He will be succeeded by Frank McNally, who was for four years manager of the Carroll County Telephone Company.

ARTHUR BESSEY SMITH, formerly professor of telephone engineering at Purdue University, addressed a meeting of the University of Michigan branch of the American Institute of Electrical Engineers at Ann Arbor on March 29. The subject of Mr. Smith's address was "The Art of Modern Telephony."

SVANTE ARRHENIUS, Sweden's most celebrated scientist, who took a prominent part in the International Electrical Congress at St. Louis as honorary chairman of Section A, is now in this country. On March 25 he delivered an address at the National Museum in Washington, D. C., on "The Sidereal Cultus." The occasion of his visit to America is the delivery of the Silliman Lectures at Yale University, which began on March 29, and deal with the subject, "The Theories of Solutions." Professor Arrhenius is now director of the Nobel Institute at Stockholm. He is an authority on the aurora borealis and other manifestations of atmospheric electricity.

OBITUARY.

JAMES HAVILAND, who helped Ezra Cornell build the first telegraph lines in this country, and who constructed the first telegraph lines in the Middle West, died on March 19 in Brookline, Mass. Mr. Haviland was born in Elmira, N. Y., in 1825.

NATHANIEL THAYER, capitalist, railroad promoter and officer in a number of corporations, died March 21 at his home in Boston, Mass. Mr. Thayer was a director of the American Bell Telephone Company and also of the American Telephone & Telegraph Company.

MARCUS D. CRAIN, for twenty years night chief operator of the Western Union Telegraph Company in St. Louis, died on March 27 at the age of seventy years. He had been in the employment of the telegraph company fifty years During the Civil War he was chief of the telegraph field corps and served in that capacity with Col. R. C. Clowry, former president of the Western Union Telegraph Company.

JACOBUS H. VAN'T HOFF, professor in the University at Berlin and one of the pioneers of modern electrochemistry, died in the suburb of Steglitz, on March 1. While Professor van't Hoff is best known as a chemist, he nevertheless has a wide reputation among electricians as one of those who developed the theory of ionization. He was born at Rotterdam, Holland, on August 30, 1852. After attending various universities he became in 1876 a lecturer on physics at Utrecht. Two years later he went to Amsterdam as professor of chemistry, and remained there until 1896, when he was called to Berlin, a new laboratory being especially equipped for him. He may be regarded as the founder of stereochemistry. He did a great deal of work in physical chemistry and showed that the gas law could be applied to osmotic pressure. Professor van't Hoff was honorary member of many academies and learned societies. In 1901 he was awarded the Nobel prize and he was also the recipient of the Helmholtz medal of the Prussian Academy, a very exceptional honor.

FREDERICK LIVINGSTON HART, eldest son of Frederick and the late Nellie L. Hart, died on Thursday, March 23, 1911, at the residence of his brother-in-law, Dr. Ralph D. Macfarland, 53 Clinton Ave., Jamaica, N. Y. Mr. Hart was born in the Cypress Hills section of Brooklyn, N Y., on July 3, 1861. He was a graduate of the Brooklyn Polytechnic Institute after which he entered the steam engineering works of William Wright, Newburg, N. Y. After completing his course of instruction there he took a course in electric lighting at the United States Electric Lighting Company, Newark, N. J. He was then appointed engineer in charge of installing and operating the electric plant equipment of the New York & Brooklyn Bridge.

Then for seven years he was superintendent of operation of the 125th Street and Tenth Avenue Railway Company, later resigning to accept an offer as engineer in charge of the Metropolitan Railway Company. He remained there two years and then was made manager of the Baltimore City Passenger Railway, which position he held for six years, when he became general manager of the Washington Railway & Electric Company of Washington, D. C. He remained here for two years when he returned to Baltimore and became associated with the firm of Thomas Basshor, contracting engineers. About two years later his health began to fail and he returned to New York, making his home with his father and brother at 116 Warwick Street, Brooklyn, N. Y. He was a member of the Stella Lodge and Kismet Temple. He was also a member of the American Society of Mechanical Engineers.

NEW PUBLICATIONS.

PROCEEDINGS OF THE MINNESOTA ELECTRICAL ASSOCIATION.—The proceedings of the third annual convention of the Minnesota Electrical Association, which was held at Minneapolis in 1910, have been printed in book form. Reports of the various committees are included as well as the papers which were read before the body.

GRAPHITE.—A report on the production of graphite in 1909, prepared by Edson S. Bastin, has just been published by the United States Geological Survey as an advance chapter of the Surveys volume "Mineral resources of the United States, calendar year 1909," and may be obtained free of charge by applying to the Director of the Survey at Washington. In 1909 most of the crystalline graphite produced in this country came from New York, Pennsylvania, and Alabama; Georgia ranked first as a producer of amorphous graphite, but the product was of very low grade. The output of crystalline graphite was the largest yet recorded for any year and the total value of the products of both kinds of graphite was the greatest. The report contains statistics of the production and imports of graphite and notes on the industry by States and Territories, as well as a select bibliography.

THE STRENGTH OF OXYACETYLENE WELDS IN STEEL, by Herbert L. Whittemore, has just been issued as Bulletin No. 45 of the Engineering Experiment Station of the University of Illinois. The welding of metals by fusion under a blowpipe flame of acetylene, burning in a stream of pure oxygen, is a commercial process which, in recent years, has come to be widely used for welding thin pieces of metal and for repair work. By this method of fusion, known as autogenous welding, not only wrought iron and steel, but also cast-iron, copper and other metals can be welded; in fact, in some cases, dissimilar metals have been welded by this process. The strength of welded joints made by this process with thin steel plates is discussed in the above bulletin, and the results of an extensive series of tests recorded. A considerable amount of information as to the convenience and efficiency of various methods of manipulating the oxyacetylene blowpipe flame is given, and it is shown that with careful manipulation a welded joint between thin steel plates may be expected to have a strength of about eighty-five per cent of that of the solid steel plates. The process is particularly adapted to welding thin plates and machine parts.

PROPOSALS.

POST OFFICE, McKINNEY, TEX.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 21 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post office at McKinney, Tex., in accordance with the drawings and specifications, copies of which may be had from the custodian of site at McKinney, or at the Supervising Architect's office, Washington, D. C.

POST OFFICE, BRADDOCK, PA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 24 for the construction, complete (including plumbing, gas piping, heating apparatus, and electric conduits and wiring), of the United States post office at Braddock, Pa., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Braddock, or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule Number.
April 11—Cable, communcation		2,500 feet	Brooklyn, N. Y.	3443
	Conductor, single	20,000 feet	Brooklyn, N. Y.	3443
	Sockets, key, bronze	600	Brooklyn, N. Y.	3443
	Wire, single conductor	14,000 feet	Brooklyn, N. Y.	3443
April 18—Grinder, portable electric		1	Annapolis, Md.	3453
April 25—Motors, induction		16	Mare Island, Cal.	3450

INDUSTRIAL ITEMS.

ALFRED F. MOORE, Philadelphia, Pa., has mailed a calendar advertising weatherproof wire, rubber-covered wire, magnet wire and telephone cords.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., describes in No. 10, of *Condulet Talks*, its type "R," "RC," "RL," "RT," "RX" and "RA" condulets, giving illustrations of each.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., devotes the March number of the *J-M Roofing Salesman* to a description of the use of J-M products in West Virginia.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., has mailed to the trade another of its attractive folders, advertising "X Duct" galvanized conduit for electric wiring.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Chicago, Ill., is distributing its March bulletin descriptive of the courses offered and of the facilities available by students in the courses.

THE DUPLEX-METALS COMPANY, Chester, Pa., quoted on March 22, a price on copper-clad steel wire of thirteen cents per pound. This is the lowest price that the company has ever quoted on its product.

THE MITCHELL-RAND MANUFACTURING COMPANY announces that on March 27 its offices were moved to the Phelps-Dodge Building, at No. 99 John Street, New York City. The company deals in electric insulating materials.

WICKES BROTHERS, Saginaw, Mich., have distributed their March stock list of machinery bargains. The company deals in new and second-hand machinery and also builds special machinery according to the needs of the buyer.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., recently sent out Bulletin No. 24 describing Diehl electric ceiling and universal fans. Illustrations of various types and sizes of fans are included, together with the price of each.

LOWE BROS., INC., Aurora, Ill., describes in Catalog L a complete and varied line of ornamental boulevard-lighting standards. Engravings and descriptions used are taken from actual installations made in Aurora, the city which has the distinction of being the first to adopt this system of boulevard lighting.

THE INDUSTRIAL INSTRUMENT COMPANY, Foxboro, Mass., has devoted catalog No. 40 to a description of the complete line of Dr. Horn tachometers and tachographs. All speed measuring instruments are listed from simple speed indicators to count revolutions, to the elaborate precision variation recorder.

THE FOOS GAS ENGINE COMPANY, Springfield, O., states that on March 22 two Foos engines were shipped for use in operating one of the dams in the river improvement work near Wheeling, W. Va. This is part of an order received from the United States Government and turned out at the Foos factory for use in the river work.

THE CENTURY ELECTRIC COMPANY of St. Louis, Mo., describes and illustrates its alternating-current fan motors in a recently published bulletin. The alternating-current ceiling fan supplied by the company is a split-phase induction-motor fan and is substantially the same in design as those put on the market by them for the past few years.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has devoted Bulletin No. 1042 to a description of generating sets composed of an Allis-Chalmers generator direct connected to an American Blower Company engine. A very good account is given of the detail construction and a number of parts going to make up the engine are illustrated.

JAMES G. BIDDLE will move his place of business to the fireproof-construction Boyertown Building, 1211 Arch Street, Philadelphia, Pa., on April 1. The new quarters include a special room with floor space of about 1,000 square feet that will be devoted to a permanent exhibition of instruments from the manufacturers represented by Mr. Biddle.

THE FLOUR CITY ORNAMENTAL IRON WORKS, Minneapolis, Minn., has devoted an attractive bulletin to the subject of ornamental lighting as a city's best advertisement. The history of lighting is taken up and followed out to the most recent schemes of ornamental boulevard lighting. Another bulletin deals with the company's ornamental iron and bronze products.

THE ELECTRIC PROTECTION COMPANY OF NEW YORK has described its automatic fire-alarm system in detail in a recent publication, "The Modernization of Automatic Fire-Alarm Service." The "Airalarm" system which is used has been worked out on the theory of utilizing "spare wires" of telephone companies, further adhering to telephone practice by dividing the system into districts.

CHARLES POLACHECK & BROTHERS COMPANY, Milwaukee, Wis., announces that its new fixture catalog No. 18 is now ready for distribution. This catalog, which is well printed on heavy enameled paper, illustrates the latest designs in electric fixtures and indirect lighting. In addition to other illustrations there are a number of pages printed with four-color plates.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., describes its potentiometer in catalog No. 70. The direct-current standardization apparatus is described and illustrated and a number of drawings are presented in explanation of the methods of connection. As an appendix to the catalog a list of a number of users of the Leeds & Northrup potentiometer is given.

THE AMERICAN STEEL & WIRE COMPANY includes in its current issue of the *American Wire Rope News* an article on the use of modern wire rope in aeroplanes. Several diagrams show the method of connecting cables to the support and the article very fully describe a number of applications. Another interesting item which is included deals with the use of the modern steam dredge in land reclamation.

THE MINNEAPOLIS STEEL & MACHINERY COMPANY, Minneapolis, Minn., describes in bulletin G-100, which has recently been distributed, Muenzel suction gas engines and producers. The company has made a specialty of engine building for central station and factory use, where power is required from ten to twenty-four hours per day the year around. The bulletin is well illustrated and contains a number of diagrams.

THE DETROIT FUSE & MANUFACTURING COMPANY, Detroit, Mich., has issued a completely illustrated catalog which is of considerable importance to switch and fuse buyers. The catalog covers the entire line of "Detroit" iron-clad fuse switches and "Arkless" mechanical indicating enclosed fuses, and illustrates a number of new types of switches, showing by several photographs the operation of the "Detroit" switch.

THE AMERICAN DISTRICT STEAM COMPANY, North Tonawanda, N. Y., is mailing to the electrical trade, its bulletin No. 120 dealing with the factors that effect the cost of distributing steam for heating. The bulletin is reprinted from a paper which was read by C. R. Bishop before the Convention of the National District Heating Association which was recently held in Toledo, O. Samples of station reports are inserted to elucidate the text.

G. W. ARMSTRONG COMPANY, Chicago, Ill., lists a very complete line of electric novelties, Christmas tree outfits, etc., in its latest catalog, which has just been distributed. All of the devices are furnished with "Green Seal" dry batteries, which are also listed with a full statement of prices. Directions are included for charging small storage batteries from a lamp circuit and for connecting a number of the batteries for charging.

ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT, Berlin, Germany, has issued a bulletin describing its closed boxes containing switches for distribution of current to a number of circuits. These distribution boxes are inetnded to take the place of open distribution panels in places where dirt, dampness, vapors or exposure to rough usage would subject the apparatus to injury. These distribution boxes are arranged for from four to six circuits.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., was awarded the contract by the Vulcan Iron Works, of Wilkes-Barre, for furnishing one 200-kilowatt direct-current type-ET, compound-wound, 250-volt generator, also the switchboard that is to be used in connection with the generator. The company has received an order from the Solvay Process Company, of Syracuse, N. Y., for a 750-kilovolt-ampere, sixty-cycle, 480-volt turbine-driven generator.

THE ELECTRIC MACHINERY COMPANY, Minneapolis, Minn., describes its line of alternating-current machinery in Bulletin No. 126 which has been recently mailed to the trade. This company has for a number of years placed on the market the revolving-field type of alternator, realizing that this is the best, and has at all times kept pace with the newest methods of design and construction. Machines are furnished in standard voltages between 240 and 2,400, although special alternators wound for 120 or for 2,400 will be made to order. The bulletin includes a number of illustrations showing the field winding, the scheme of keying in the pole pieces and other details as well as the completely assembled machines.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., has prepared an attractive calendar advertising Sangamo electric meters, of which it offers a complete line, including mercury motor watthour meters for direct and alternating current, induction watthour meters, ampere-hour meters, graphic recording meters and inducting instruments. As an illustration for the calendar, a picture of the battleship North Dakota, which is equipped with Sangamo meters, has been chosen. The design is extremely well worked out. The company is also distributing a new price list covering their type H induction watthour meters. Several important changes in price are incorporated.

THE UNITED STATES ELECTRIC COMPANY, New York, N. Y., has issued bulletin No. 701 entitled, "Some Preventable Accidents," in which three of the collisions reported in the latest train accident bulletin of the Interstate Commerce Commission are studied and shown to be preventable with apparatus now available to the railways. This company's system provides, in brief, for the absolute control, by the dispatcher, of any semaphore or train-order board which he may throw to the stop position, independent of the presence of local attendants. The signal when so thrown reports itself audibly to the dispatcher and cannot be set back in the safety or proceed position until electrical permission so to do has been given by the dispatcher, although the dispatcher may clear the signal without the intervention of the train crew or station agent.

DATES AHEAD.

American Supply and Machinery Manufacturers' Association. Annual meeting, Louisville, Ky., April 3, 4 and 5.

American Electrochemical Society. Annual meeting, Chemists' Club Building, New York, N. Y., April 6, 7 and 8.

Missouri Electric, Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

Electrical Supply Jobbers' Association. Annual convention, Del Monte, Cal., April 25, 26 and 27.

American Institute of Electrical Engineers, Pacific Coast meeting, Los Angeles, Cal., April 25-28.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) March 21, 1911.

987,107. TELEGRAPH KEY. Charles Bolick, Rocky Mount, N. C. Filed Dec. 30, 1910. An attachment for telegraph keys consists of a spring latch mounted on a separate grooved base.

987,114. PROCESS FOR SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID. Frederick Gardner Cottrell, Berkeley, Cal., assignor to Petroleum Rectifying Co., San Francisco, Cal. Filed Oct. 12, 1909. Consists in passing the mixed oily liquids through a pervious septum formed of a number of electrodes and applying sufficient voltage to these to separate the two liquids, the separated and coalesced drops draining through the wetted septum to its edge.

987,115. SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID. Frederick Gardner Cottrell and James Buckner Speed, Berkeley, Cal., assignors to Petroleum Rectifying Co., San Francisco, Cal. Filed May 20, 1909. Renewed Oct. 12, 1910. An amplification of the above whereby the liquids are poured in a stream between two electrodes, the coalesced globules being prevented from forming a short-circuiting chain between the electrodes.

987,116. APPARATUS FOR SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID. Frederick Gardner Cottrell and James Buckner Speed, Berkeley, Cal., assignors to Petroleum Rectifying Co. Filed May 20, 1909. Renewed Oct. 12, 1910. Describes the arrangement of the electrodes for the above.

987,117. SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID. Frederick Gardner Cottrell and Allen Cheever Wright, Berkeley, Cal., assignors to Petroleum Rectifying Co. A modification of the above wherein one electrode is rotated to prevent short-circuiting by the coalesced globules.

987,128. TELEPHONE-EXCHANGE SYSTEM. William A. Fricke, Chicago, Ill., assignor to Monarch Telephone Manufacturing Co., Chicago, Ill. Filed April 11, 1908. Clearing-out supervisory devices are associated with the cord circuit.

987,129. TELEPHONY. William A. Fricke, Chicago, Ill., assignor to Monarch Telephone Manufacturing Co., Chicago, Ill. Filed Nov. 24, 1909. A metallic party-line exchange system has partially selective ringing.

987,136. RAIL-BOND. Albert B. Herrick, Ridgewood, N. J., assignor to Electric Railway Improvement Co., Cleveland, Ohio. Filed April 19, 1905. Is provided with a plate of carbon attached to the portion of its surface opposite to the contact surface thereof.

987,146. ALTERNATING-CURRENT ELECTROMAGNET. David L. Lindquist, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Aug. 18, 1906. An electromagnetic brake has the magnet and armature inclosed in a casing containing oil adapted to act as a dashpot.

987,149. CASH-REGISTER. Charles A. Lundgren, Dayton, Ohio, assignor to National Cash Register Co., Dayton, Ohio. Filed Jan. 15, 1903. Combined with a series of key levers are a key coupler, an accounting device, and an electric mechanism connected to the key coupler and comprising a magnetic coil and a solenoid core.

987,150. COMPUTING-MACHINE. Holmes Marshall, New York, N. Y., assignor to Addograph Manufacturing Co. Filed June 8, 1903. An electrically operated computing mechanism comprises a series of electromagnets and a set of contacts controlled thereby for operating the computing mechanism, the number of contacts set corresponding with the number to be added.

987,152. LAMP-SOCKET. Norman Marshall, Newton, Mass., assignor to Arrow Electric Co., Hartford, Conn. Filed June 7, 1909. Comprises a porcelain base, a pull-switch mechanism mounted in the base, a nut secured thereto, and a guide tube for a pull cord screwed into the nut.

987,156. TREATMENT OF SULFID ORES. James A. McLarty, Toronto, Ontario, Canada. Filed March 7, 1910. A process of treating nickel sulphide ores consists in demagnetizing the nickel ore and subsequently passing it through a magnetic separator to remove any magnetic iron ores contained therein.

987,161. ELECTRIC OVEN. George John Ogden, Toronto, Ontario, Canada, assignor of one-fifth to Martin M. Hay, one-fifth to John Templeton, and one-fifth to Roderick J. Parke, Toronto, Canada. Filed Sept. 21, 1909. Includes a thermostat which controls a motor that either opens or closes the heating circuit to maintain a uniform temperature.

987,188. ELECTRIC IGNITION SYSTEM FOR EXPLOSION-ENGINES. Oliver B. Thompson and Carl R. Moeller, Buffalo, N. Y. Filed March 24, 1910. Includes two resistances and an electromagnetic device to include either one or the other in circuit.

987,192. ELECTRICAL SWITCH. William A. Turbayne, Lancaster, N. Y., assignor to Gould Coupler Co. Filed June 16, 1908. Is provided with three electromagnet coils whose armature is arranged to close four contact gaps. By reserval of current in one of the outer coils part of these contacts can be broken.

987,193. ELECTRICAL REGULATING APPARATUS. William A. Turbayne, Lancaster, N. Y., assignor to Gould Coupler Co. Filed Feb. 3, 1909. A variable-voltage generator has in series with its load circuit a carbon-pile resistance the pressure on which is electromagnetically regulated to vary its resistance so as to maintain a constant voltage at the load.

987,194. ELECTRICAL SYSTEM OF DISTRIBUTION. William A Turbayne, Lancaster, N. Y., assignor to Gould Coupler Co. Filed Feb. 24, 1909. A storage battery and booster is provided on each car of a train, which has a train circuit and regulating devices for connecting the car circuits and batteries to the head-end generator, for cutting out the booster during discharge and for preventing battery discharge through the generator.

987,200. ELECTRIC SWITCH. Oliver B. Whipple, Saginaw, Mich. Filed Nov. 22, 1910. An inclosed fuse is mounted on the blade of a knife switch, one terminal being electrically insulated from the blade and arranged to contact with a stationary clip.

987,220. BURGLAR-ALARM PLATES. Gustav Dzerma, Bellefontaine, Ohio. Filed Nov. 4, 1909. A series of superposed floor plates has co-operating openings therein through which pass tongues attached to the base plate. Two of the floor plates are connected to opposite sides of an electric alarm circuit.

987,228. ELECTROTHERMAL CONTROLLING APPARATUS. Walter O. Haymond and John O. Potter, Muncie, Ind. Filed July 7, 1909. Renewed July 26, 1910. A thermostat electromagnetically controls the switch of an electric motor which operates a damper mechanism.

987,239. SNAP-SWITCH. Charles Julius Klein, New York, N. Y. Filed Feb. 20, 1908. Renewed July 30, 1910. A pendant switch with a reciprocating button.

987,240. SNAP-SWITCH. Charles J. Klein, New York, N. Y. Filed Sept. 20, 1907. Renewed Oct. 24, 1910. Comprises a cam having oppositely inclined faces, a switch member pivotally mounted upon a fixed support, a helical tension spring having coils engaging the cam and operatively connected to the switch.

987,241. SNAP-SWITCH. Charles Julius Klein, New York, N. Y. Filed Feb. 20, 1908. Renewed Oct. 24, 1910. A modification of No. 987,239.

987,245. ADVERTISING DEVICE. Roy Langstaff, Los Angeles, and George A. Langstaff, Whittier, Cal. Filed June 7, 1910. A spring motor rotates an art-glass dome within which is a cluster of incandescent lamps.

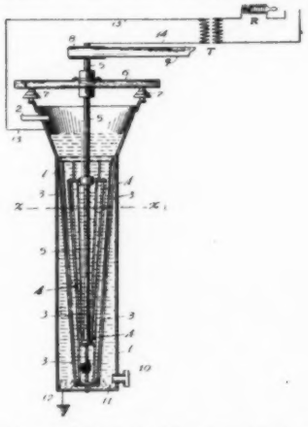
987,253. CABLE TRANSPORTATION SYSTEM. Frank Neale, Hood River, Ore. Filed Aug. 30, 1909. An electric motor drives the cable sheaves.

987,254. ACTUATING MEANS FOR ELECTRIC-METER RECORDERS. Carl Madison Page, Dixon, Ill. Filed Aug. 30, 1909. A conducting contact roller carries intermediate its ends a slidable member (composed partly of conducting and partly of insulating material), which is reciprocated so as to make and break the circuit.

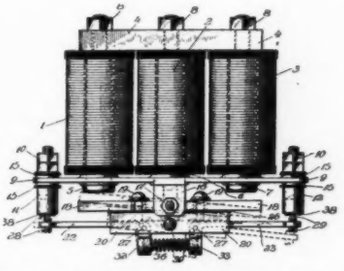
987,270. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Co. Filed Feb. 21, 1908. A three-phase system has a regulating storage battery connected to it through transformers and a rotary converter. In series with the battery is a motor-driven booster whose field is energized through a rectifying machine driven by a synchronous motor and fed by current transformers.

987,274. ILLUMINATED SIGN. Hugo E. Westerberg, Seattle, Wash., assignor of one-half to John A. Soderberg, Seattle, Wash. Filed Feb. 8, 1909. A row of lamps forming characters has the lamps lighted one by one by an illuminated motor-driven pointer that travels along the tortuous path of the characters. After all lamps are lighted they are suddenly extinguished and the cycle repeated.

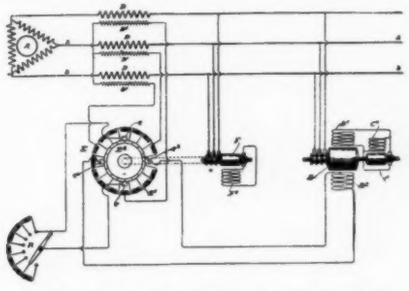
987,293. ELECTRICALLY-HEATED MATRIX-PRESS. Horace B. Gale, Natick, Mass., assignor to Simplex Electric Heating Co., Boston, Mass. Filed Feb. 10, 1910. A thermostat automatically cuts off the current from the heating elements when a certain maximum temperature is reached. It also prevents the circuit being closed till the temperature drops below a certain point.



987,117.—ELECTRICALLY SEPARATING WATER FROM OIL.



987,192.—MULTIPLE-CONTACT SWITCH.



987,300.—POWER-FACTOR COMPENSATOR.

987,300 and 987,301. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Co. Filed June 22, 1907. The first patent covers a system of power-factor correction through a synchronous motor having one field circuit excited by a constant current and another by a current that varies with the power factor of the line. The second patent covers a system containing such a power-factor compensator and also a storage battery for regulating the voltage with changes of load.

987,304. TELEPHONE. William J. C. Kenyon, Chicago, Ill. Filed June 1, 1908. Renewed Nov. 25, 1910. A desk telephone has a flexible arm for holding the receiver to the ear.

987,306. SNAP-SWITCH. Charles J. Klein, New York, N. Y. Filed Sept. 20, 1907. Renewed July 30, 1910. A reciprocating push-button switch (modification of No. 987,240).

987,318. MANUFACTURE OF THIN ELECTROLYTIC IRON PLATES OF LARGE AREA. Wilhelm Pfanhauser, Leipzig, Germany. Filed Sept. 28, 1910. Comprises the electrolysis of a solution of iron salts, and the maintenance of the solution, during such electrolysis, at a temperature of approximately 80 degrees centigrade.

987,338. SWITCH. Ernest E. Yaxley, Chicago, Ill., assignor to Monarch Telephone Manufacturing Co., Chicago, Ill. Original application filed Sept. 26, 1905. Divided and this application filed July 21, 1906. A combined telephone spring-jack switch and magneto drop.

987,339. ELECTRIC GAS-IGNITING FIXTURE. Herman Younker, Louisiana, Mo. Filed May 27, 1910. An inverted-mantle gas burner has an electric igniter operated when the gas is turned on.

987,345. ELECTRICAL DEVICE FOR CONTROLLING UNRULY ANIMALS. Asa F. Cogswell, Kirwin, Kans. Filed Sept. 21, 1909. Contact plates are mounted on different parts of a horse's harness; these are electrically connected through selective keys in a hollow hand-hold of the reins to a source of current in a belt carried by the driver.

987,356. ELECTRIC-LAMP-SOCKET CAP. Gilbert W. Goodridge, Bridgeport, Conn., assignor to Bryant Electric Company, Bridgeport, Conn. Filed Jan. 10, 1911. Has a shouldered skirt with latching elements thereon, the shoulder being perforated, in combination with an inclosing ring having tongues entering the perforations of the shoulder and being offset to lock the ring on the cap.

987,357. ELECTRIC-LIGHT SWITCH FOR TELEPHONE-BOOTHS. Samuel M. O. Grant, Pittsburg, Pa. Filed May 5, 1910. A pair of spring-controlled rods are connected to the source of current and adapted to engage in the sockets of two contact pieces.

987,358. MOTOR-VEHICLE. Emil Gruenfeldt, Cleveland, Ohio, assignor to Baker Motor Vehicle Co., Cleveland, Ohio. Filed Dec. 28, 1909. An electric vehicle has its motor connected by a longitudinally arranged shaft to a differential driving gear in the rear axle.

987,361. ENGINE HEAT-RADIATING STRUCTURE. John W. Hasburg, Chicago, Ill. Filed March 6, 1906. Around the cylinder are a number of thin large-diameter cooling blades and screwed on the cylinder. A uniting coat of metal is electroplated over the entire surface after the disks are assembled.

987,384. ROPE-DRIVE ELEVATOR. David L. Lindquist and August Sundh, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed Dec. 15, 1908. The traction sheave is driven by an electric motor. Tensioning devices are provided for the cables.

987,404. ELECTRIC INDUCTION-FURNACE. Wilhelm Rodenhauser, Volklingen-on-Saar, Germany, assignor to The Grondal Kjellin Co., Limited, London, England. Filed Nov. 3, 1908. The primary coil is wound on a core which pierces the hearth. The core comprises sheet metal laminae, the width of each of which is considerably greater than the total thickness of the assembled laminae, the broad face of the core facing the open working portion of the hearth.

987,414. ELECTRIC-LAMP SOCKET. George B. Thomas, Bridgeport, Conn. Filed Jan. 11, 1911. Comprises an insulating casing with rectangular recess therein, a coil within the casing forming a side contact for a lamp base, the coil having its free end offset to form a lug engaging the sides of the recess in the casing with lost motion on either longitudinal or rotary displacement.

987,428. APPARATUS FOR THE TREATMENT OF ORES AND FOR THE ELECTROLYTIC DEPOSITION OF GOLD AND SILVER AND OTHER METALS FROM SOLUTIONS CONTAINING SAID METALS. Frederick Capel Brown, Komata, New Zealand. Filed Aug. 5, 1907. The ore pulp is kept in circulation by fluid passing through two pipes, and electric current is furnished to deposit the precious metals.

987,441. CURRENT-CONTROLLING APPARATUS. William N. Dickinson, Jr., Brooklyn, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Oct. 23, 1905. Combines with an electric motor, reversing switches, a pilot motor, a fixed support to which the pilot motor is pivoted, switch arms secured to a part of said pilot motor, and a fixed base carrying one set of contacts of each reversing switch.

987,446. PUSH-BUTTON CONTROL FOR ELEVATOR AND DUMB-WAITER SYSTEMS. Edward L. Dunn, Worcester, Mass. Filed Feb. 14, 1908. The elevator is controlled by a system of push-buttons so arranged that when one button is pushed all others are ineffective. Means are provided whereby the pushing of one button establishes, controls and maintains the circuits automatically to operate the device.

987,483. TUNGSTEN INCANDESCENT LAMP. John J. O'Brien, Shamokin, Pa. Filed June 1, 1910. A plurality of branches radiate from each of the lead-in wires, one set of branches being of different length from the other set.

987,493. ELECTRIC WATER-HEATER. Herbert N. Roche and William Ruth Ray, San Francisco, Cal., assignors to Thomas

B. Gray, San Francisco, Cal. Filed Aug. 3, 1910. A pair of walking-beam arms are attached to the electric switch so that when the water is turned on the electric current flows, heating the water.

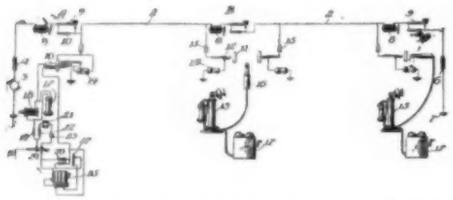
987,495. ALTERNATING-CURRENT PLANT COMBINED WITH STORAGE BATTERY. Ludwig Schroder and Adolph Muller, Berlin, Germany. Filed Oct. 7, 1904. A motor generator set composed of a three-phase alternating-current machine and a direct-current machine has its alternating-current-side connected to the alternating-current mains and its other end to a storage battery, which also energizes the field windings. A rotary converter driven through a transformer by the alternating-current power supplies a bucking field to the direct-current machine.

987,515. INSULATING-HANGER FOR TROLLEY-WIRES. John L. Wagner, Syracuse, N. Y. Filed April 30, 1910. Comprises an insulating member constructed with an overchanging drip flange and a surrounding groove immediately beneath the flange and sheltered by it. Jaws which are provided with a clamping member for holding the wire screw to the bottom of the insulator.

987,536. METHOD OF AND APPARATUS FOR COOLING ELECTRICAL GENERATORS AND MOTORS. Frank George Baum, San Francisco, Cal. Filed Sept. 7, 1910. Moist air is blown forcibly into the generator, the heat of the generator being used to evaporate the entrained particles of water.

987,562. ELECTRIC-LAMP CHANGER. Mark Ferguson, Pasadena, Cal. Filed April 29, 1910. Comprises a plurality of jaws, a supporting head, a ring detachably secured to the head and forming a common pivot for the jaws, and means for actuating the jaws, the jaws and ring being removable from the head as a unitary structure.

987,563. TELEPHONE ATTACHMENT. Charles L. Fields, Rochester, Ind. Filed July 9, 1910. Comprises a mouth piece open at both ends to be applied to the mouth of the user and to the mouth piece of a telephone transmitter, ear covers, a support for the covers, and flexible sound-conducting members connected with the mouth piece intermediate its ends and with the ear covers.



987,582.—TELEGRAPH AND TELEPHONE SYSTEM.

987,581. SNAP-SWITCH. Samuel Korf, Chicago, Ill., assignor to The Wi-Ko Electric Co., Chicago, Ill. Filed June 16, 1910. A pull chain operates a ratchet wheel which in turn actuates an electric snap switch. Detent means preveat the ratchet from turning in the wrong direction.

987,582. TELEGRAPH AND TELEPHONE SYSTEM. Otto T. Lademann, Milwaukee, Wis., assignor to Railway Telephone & Electric Co., Chicago, Ill. Filed July 24, 1908. The telephone instruments are connected around relays in the telegraph line so as to obviate interference from this source. High-frequency signal devices are used for the telephonic units of the system.

987,622. ELECTROLYTIC CELL. Victor E. Goodwin, Schenectady, N. Y., assignor to General Electric Co. Filed Sept. 1, 1909. Has a plurality of trays each having an opening through it and a trough for electrolyte encircling the opening, and means for supporting the trays from their edges so that the openings are unobstructed.

987,630. QUADRUPLEX TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed Aug. 10, 1910. Two batteries of opposite polarity are inserted in the line and two transmitting means, one including a shunt circuit and a coil of an electromagnet, the second including a shunt circuit and the armature and forward stops of the electro-magnet, are used.

987,631. QUADRUPLEX PRINTING TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed Sept. 3, 1910. The system has four transmitting organisms, two for each terminal, each organism comprising a localized differential polar relay and means to actuate the relay in accordance with the characters desired to be transmitted and comprising for both stations of each terminal two sources of current in opposition as to each other and means to shunt, with the aid of the relay of one or the other of the stations, one or the other of the batteries.

987,632. SNAP-SWITCH. Charles Julius Klein, New York, N. Y. Filed Feb. 20, 1908. Renewed Oct. 24, 1910. A snap switch operated by a push button.

987,637. LOCKING-KEY. Frank R. McBerty, New Rochelle, N. Y., assignor to Western Electric Co., Chicago, Ill. Filed Sept. 5, 1908. Renewed Aug. 2, 1910. Comprises a bar of magnetizable material, means for inducing a plurality of positive and negative poles, a plurality of pole pieces adapted to co-operate with the poles, and a plurality of keys having armatures movable in the field of the pole pieces.

987,647. PRIMARY BATTERY. Charles B. Schoenmehl, Waterbury, Conn. Filed Feb. 4, 1910. A zinc positive electrode is surrounded by a compressed cylindrical oxid of copper negative electrode. This in turn is surrounded by a cylindrical zinc positive electrode. All are suspended by one rod.

987,647. BATTERY-ELEMENT SUPPORT. Charles B. Schoenmehl, Waterbury, Conn. Filed Dec. 9, 1910. An annular perforated basket contains oxid of copper scale and constitutes a negative electrode. The zinc electrode is suspended within the basket.

987,650. METERING ELECTRICAL DISTRIBUTION SYSTEM INCLUDING A METERING PANEL-BOARD. Frederick F. Skeel, Chicago, Ill. Filed Aug. 7, 1905. Comprises a base of insulating material, main feed wire terminals mounted thereon, a plurality of sets of meter circuit terminals also mounted on the base, and a plurality of sets of load circuit terminals mounted on the base.

987,658. ELECTRIC HEATER AND STERILIZER. Johann G. Wallmann, Oakland, Cal. Filed Nov. 8, 1909. A vessel having top and bottom openings is provided with a plurality of electrodes of opposite polarity having central openings in alinement with the bottom opening alternately spaced therein, and current-conducting means leading through the handle and to the elements.

987,663. ELEVATOR. Parvin Wright, Los Angeles, Cal. Filed August 25, 1904. The cylinders of the elevator are operated by hydraulic pressure, water being supplied by an electric-motor driven pump.

987,669. FIRE PROTECTING AND SIGNALING APPARATUS. Adolf Bush, Riga, Russia. Filed Oct. 27, 1909. An electromagnet actuated by a thermostat sets clockwork in motion, the clockwork then turning a valve and operating a signal.

987,673. ELEVATOR-OPERATING SYSTEM. Edward L. Dunn, Worcester, Mass. Filed July 2, 1906. A rotatable knob or handle controls the destination of the car, magnetic means being provided for positively locking the knob or handle against reverse motion after it is started to move in either direction. The circuit is so arranged that if any elevator door is left open the motors become inoperative.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired on March 27, 1911:

517,017. INCANDESCENT ELECTRIC LAMP. Richard P. Ashwell, Newark, N. J., and George Q. Tuttle, New York, N. Y.

517,018. SECONDARY BATTERY. George L. Ballard, Toronto, Canada.

517,028. ELECTRIC RAILWAY TROLLEY. Frank S. Church, Detroit, Mich.

517,042. ELECTRODE FOR ARC LAMPS. Salomon Heimann, New York, N. Y.

517,069. ELECTRIC LAMP. Frederiek C. Rockwell, Hartford, Conn.

517,100. ELECTRIC SWITCH. Jacob S. Gibbs, Hartford, Conn.

517,105. ELECTRIC MOTOR OR DYNAMO-ELECTRIC MACHINE. John W. Henderson, Philadelphia, Pa.

517,120. SAFETY CUT-OUT FOR ELECTRICAL APPARATUS. Hermann Lemp and Merle J. Wightman, Hartford, Conn.

517,162. ELECTRICAL MEASURING INSTRUMENT. Rudolph M. Hunter, Philadelphia, Pa.

517,163. ELECTRICAL INDICATOR. Arthur E. Kennelly, Orange, N. J.

517,169. ELECTRIC APPLIANCE FOR DUMB-WAITERS. James H. Roberts, Brooklyn, N. Y.

517,170. ELECTRIC HEATER. Leslie B. Rowley, Ashland, Wis.

517,214. ELECTRIC VENTILATING FAN. Charles W. DeMott, Brooklyn, N. Y.

517,243. SINGLE-LINE TELEPHONE SYSTEM. John I. Sabin and William Hampton, San Francisco, Cal.

517,258. ELECTRICAL RAILWAY. Benson Bidwell, Philadelphia, Pa.

517,263. TELEPHONE SWITCH. Frank R. Colvin, New York, N. Y.

517,299. ELECTRIC CALLING APPARATUS. David Hall Rice, Brookline, Mass.

517,401. CIRCUIT CLOSER. Charles E. Allen, Salem, Mass.

517,402. ELECTRICAL KEYBOARD. Charles E. Allen, Salem, Mass.

517,419. ELECTRICAL APPARATUS FOR CONTROLLING SIGNALS. Michael B. Leonard, Richmond, Va.

Reissues.

11,408. ELECTRIC ELEVATOR. Frank E. Herdman, Winnetka, Ill.

11,409. ELECTRICALLY-OPERATED ELEVATOR. Frank E. Herdman, Winnetka, Ill.